CHEMICAL & METALLURGICAL ENGINEERING

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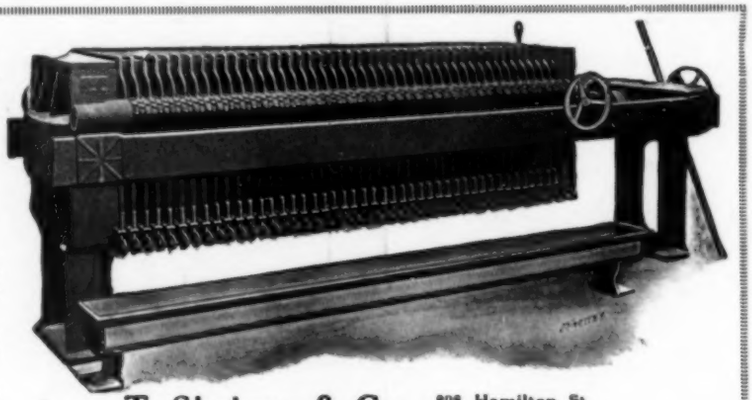

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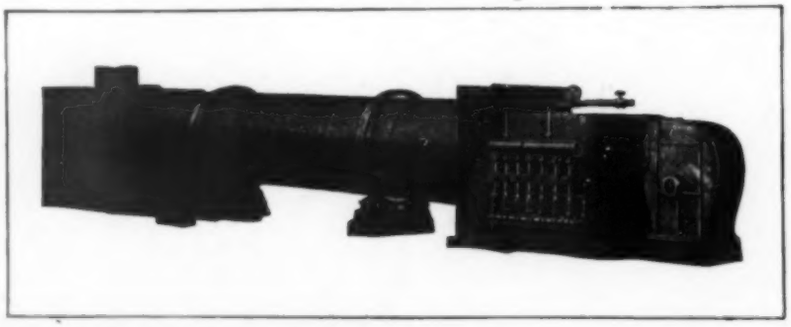

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Fourth Liberty Loan To Be a Victory Loan

NEXT month the Government will call upon us to support the fourth great loan to aid in winning the war, and the opportunity to help should be acclaimed with joy by every loyal American. If pride in the achievement of our troops is ever to find expression, and if we are determined to see that their sacrifices have not been made in vain, now is the time to act. The nearer we approach the day of victory, the greater the necessity for unwavering support of our cause. Thus the coming loan will be a real test of loyalty and confidence.

We want to be able to look every returning soldier squarely in the eye and feel that we matched his service with our dollars. Over one and one-half million of our troops are now abroad, and if they need billions of dollars to furnish them food and munitions they should but have to make their needs known to have them supplied. The issue of bonds for the fourth loan probably will equal or exceed six billions of dollars. Taxation will account for another eight billions, but if our war program for the fiscal year ending June 30, 1919, calls for twenty-four billions we will still have some money to raise.

These sums should not stagger us, for they are but a fraction of our national resources which, as Thomas W. Lamont recently pointed out, were estimated at the beginning of the war at $250,000,000,000. The total sum derived from Government securities to date is but $9,978,785,000, so that we still have plenty of reserve. When the fourth loan is called for on September 28, let us make our subscriptions part of the day's business and return to our task of winning the war as speedily as possible.

Distinguishing Between Essentials and Non-Essentials

ONE of the clearest recollections of our "prep" days in chemistry is the wise injunction given by an excellent teacher, to "learn to distinguish between essentials and non-essentials." Specially applicable to the study of science and the cultivation of keen observation, the lesson is useful wherever efficiency is paramount, whether it be in the conduct of a government at war or in the pursuit of our usual vocations.

Early in our participation in the war a great deal was said about essential and non-essential industries, and there was much speculation as to how such classification could be made. Obviously a hard and fast line could not be drawn, and we believe there would have been less confusion and misunderstanding if it had

been made plain that the essentiality of different industries in war time is a relative matter and that conditions were likely to change as time went on. Emphasis should have been laid on the fact that different lines of business were *more* or *less* essential to the winning of the war, and that the classification was certain to change from time to time.

With accumulated experience we have adjusted ourselves to the rulings of the War Industries Board because we have recognized the necessity of centralizing control in one body; also we have been impressed with the sanity of most of the Board's rulings. Furthermore, the spirit of pessimism which earlier prevailed on account of the fear that the list of essential industries would become more and more restricted, may now give way to optimism over the fact that the list is actually expanding. The War Industries Board is formulating a new list of "preferred" industries, which will be about twice as long as the one issued last April containing thirty-two classes. War needs have actually expanded, and civilian demands also have pressed for relief.

The preference list will be a key to the relative importance of the country's manifold industries. That it will be fair and based on sound judgment is assured from the fact that the values are determined by surveys of national needs. Once established, the list will be maintained by a system of priority in determining the use of the six basic elements of industry which are: material, facilities, fuel, transportation, labor and capital.

The publication of the new list will do more than determine the relative essentiality of different lines of business: it will draw a line for the enforcement of the work-or-fight ruling of the War Department. Men, otherwise exempt, who are engaged in any of the preferred industries will be regarded as engaged in war work, and therefore contributing as much to the winning of the war as though they were fighting. It looks as though we are distinguishing quite clearly between essentials and non-essentials.

Chemical Exposition to Be Held This Month

RUMOR has been rife to the effect that the Fourth National Exposition of Chemical Industries would have to be abandoned because the Government had requisitioned Grand Central Palace for a base hospital. We are glad to be able to announce that, although the Palace is to be taken over by the Government, the plan will not interfere with the holding of the Exposition as planned for the week of September 23. Mr. Alfred I. duPont, owner of the leasehold on Grand Central Palace, recently announced that he had met the Government's request for the building and had notified tenants to vacate by September 15. At the same time it was made known that the Government would not require that portion of the building used for the exposition until October 1, by which time the exhibits could be removed. Meanwhile plans that have been under way for almost a year indicate that the exposition will be larger and better than ever, and will fittingly represent the industry which is growing so rapidly.

Chemistry in Modern Warfare

THE reader will find much of interest and suggestion in the article, published elsewhere in this issue, describing the phenomenal growth of the Chemical Warfare Service, National Army. The title of the Service itself is a tribute to the importance of the science and a recognition of the extent to which chemists have been called to the colors. History records the stink-pot of the Chinese as a device for gas warfare, but we have no previous knowledge of a corps of eminent chemists engaged in research to discover the most effective gases for rendering an adversary *hors de combat;* nor of large factories devoted to the making of the said gases; nor of shell-filling stations where missiles are charged with the deadly stuff. All this has been reserved for the year of grace 1918 when the more civilized nations of the earth are trying to annihilate Hohenzollernism with its own diabolical devices.

Little has been said in public about our work in gas warfare because secrecy is essential to success. The strategic value of gas warfare lies in the element of surprise. If the enemy can be caught without protection against a new gas, its use will prove effective until he can determine its nature and provide means for nullifying its action. Once he has succeeded in developing defensive measures, further attacks with that particular gas may not prove very effective. Hence the impossibility of publishing the results of the research in gas offense. This, however, need not prevent a full knowledge on the part of the chemical profession of the magnificent work which its members are doing in the present war. The commissioned personnel is practically a list of chemical leaders in the United States.

Germany's Finger in the Platinum Pie

OUR editorial under this caption in our last issue has evoked letters of protest from Charles Engelhard and Baker & Co., Inc., which we are glad to accord space in the columns regularly devoted to the views and comments of our readers.

Gold Mining An Essential Industry

THE Priorities Board of the War Industries Board has formally resolved that gold mining is an essential war industry, and as such is entitled to certain preferential treatment. Accordingly the powers of the Board will be exercised to see that gold mines get tools, machinery, equipment, transportation service, fuel and labor.

Of course the War Industries Board is not responsible for the predicament of gold mining, neither can it alleviate its sufferings by resolution, although the latter will obviate the cost of delays which are often serious. The gold mining industry needs something more than resolutions or even fuel, labor and supplies. It needs these things at normal cost or else an enhanced value of its product. Since the latter is not likely to materialize, the next form of assistance which suggests itself is the bonus. The closer the cost of producing gold approaches $20.67 per ounce, the sooner we will

have to choose between supporting the industry or seeing it languish and die.

At the beginning of the war we pointed out the economic advantage accruing to the Allies from the fact that they controlled the production of gold. Great Britain alone controls 60 per cent of the world's output, and the Allies today control well over 90 per cent. If this item is an advantage now, it must prove even more effective after the war. And if we expect to retain that advantage in the face of a decreasing production of gold we must take measures for support of the industry.

Gold production is falling off, the world over. Transvaal production for May 1918 was only 741,317 fine ounces compared with 779,385 fine ounces in May, 1917. United States production has declined from a value of $101,000,000 in 1915 to $84,000,000 in 1917.

Gold producers in the United States recently met at Reno, Nevada to consider what should be done to avert collapse of the industry. It is quite evident from reports of the meeting that sanity and good judgment prevailed. The assembly expressed the frank opinion that, without assistance, gold mining is likely to fall off alarmingly in this country. Government relief for producers to correspond with the increased cost of production was held to be a necessity, but any thought of altering the value of gold or disturbing our financial system was deprecated. Sound money was recognized as absolutely essential even if gold mines have to close for a time.

Iron Contents Of Iron Ores

THE fact that iron industries throughout the world thrive under quite divergent conditions suggests that there are compensations. Industries that are well fixed in some respects are not nearly so well fixed in others. If it were otherwise, the competitive condition could hardly be maintained as well as it has been.

Thus one observes that Sweden has large reserves of iron ore of exceptional purity, practically the plain oxide, but some of the ores lie within the Arctic Circle, and there is no fuel except charcoal and "white coal" which lately has been applied to advantage. Sweden has iron-producing companies that have been in continuous existence for several centuries. Then there is the very low iron content of the Minette ores of Lorraine, but by admixture a self-fluxing charge can be made. Great Britain supports an iron industry with both classes, extremely lean native ores and very rich ores brought from Spain. India, China and Japan have certain advantages and disadvantages, and if they had an even start with Great Britain or even the United States, they would now have flourishing iron industries of very considerable size.

In each of these cases there is a mixture of advantages and disadvantages and so each has a place as an iron producer and, except in the case of Sweden, as a steel producer of corresponding size. Here in the United States we have had a situation which has been frequently looked upon as follows: In the South and in Virginia we have rather lean ores which on account of their close association with coal and limestone deposits can be worked to advantage and the product shipped very considerable distances. Also we have the rich Lake Superior deposits, not associated with coal or limestone, which on account of their richness can be transported great distances, say a thousand miles, for smelting. Then, not to mention various smaller districts, we have the Atlantic seaboard, which can bring rich ores from Cuba and Chile and on occasion from Sweden, and not absolutely barred from using Lake Superior ore.

This is, perhaps, the common picture, but as to the Lake Superior ores it is based partly upon conditions that have been slipping away for well nigh two decades. That is a fact that must be faced by the heads of producing concerns using Lake Superior ores and also by those who contemplate establishing new plants dependent upon those ores. From time to time decisions must be made by the captains of industry having regard to the analysis and physical properties of the Lake Superior iron ores available.

To metallurgical and mechanical engineers it is a fact that must be present all the time and must affect practically the daily work. The development of each of the Lake Superior ranges was predicated upon iron contents, natural state, well up in the sixties. There remains some rich ore, but not nearly as much as formerly, and with the quintupling of the production in a double decade the mass of rich ore has been so greatly diluted that it hardly makes an impress in the final reckoning. That reckoning is compiled annually by the Lake Superior Iron Ore Association, whose latest report shows that the average iron content of the 62,616,045 gross tons of iron ore shipped from the Lake Superior region in 1917 was 51.3812 per cent, natural state, as shipped. That is many units removed from the iron content that made the Lake Superior region famous. To put the matter flatly, if until this date the Lake Superior region had been shut off from human ken, and we had our present iron-producing districts, Alabama, Virginia, Atlantic seaboard etc., and suddenly these 51 per cent Lake Superior ores were offered, there would be no great rush to build an iron and steel industry upon them.

The industry, however, is strong, vigorous and growing. The credit must be given not to Nature but to the mechanical and metallurgical engineers, to their steam shovels which were handling more overburden or ore per shovel than those whose achievements in digging the Panama Canal attracted world-wide attention, to the wonderful Lake carriers receiving and discharging in a very few hours burdens running into five figures, to the automatic appliances at 600-ton blast furnaces, to all the metallurgical and mechanical devices used in converting Lake Superior ores into finished steel products. The average content of Lake ores shipped has been declining at the rate of about one unit in every three or four years and there is no reason to expect that the decline will not continue, though probably at a somewhat lower rate in future. This decline is going to keep the engineers busy if the industry based upon Lake Superior iron ore is to continue to grow in decades to come, or even to maintain its present tonnage. The industry cannot rest with the methods and appliances it has now. Year by year improvements must be made to compensate for declining iron units in an ore that must often travel more than a thousand miles.

Readers' Views and Comments

Need of Optical Instruments in Industrial Laboratories

To the Editor of Chemical & Metallurgical Engineering

SIR:—A few days ago the writer learned from the chief chemist of a well known packing house, that at this time they are in need of a number of refractometers.

Now I can recall at least three well known physics laboratories that are in possession of at least one good refractometer each, and moreover I am quite certain that these instruments are not in constant use.

It seems to me, therefore, that some definite relation should exist between these laboratories and the essential industries. Not only should this apply to refractometers but to other optical instruments that are difficult to obtain just now. With our small classes and no research work many polariscopes, colorimeters, optical pyrometers, etc., might be turned over to the industries for the duration of the war.

Personally, I see no reason whatever why the Government might not ask for a list of all such instruments from the physics laboratories of the country, in order that, should it seem desirable, these instruments may be called for so that the industries might have the use of them.

Practically all of them were brought into this country duty-free, so that the industries could afford to buy them from colleges at the prices they paid for them and the colleges would thereby lose nothing.

Again they could, to be sure, be loaned for the period of the war.

G. A. SHOOK.

Williamstown, Mass.

Germany's Finger in the Platinum Pie

To the Editor of Chemical & Metallurgical Engineering

SIR:—I desire to protest most energetically against the reference to me contained in your recent editorial, entitled "Germany's Finger in the Platinum Pie," and I submit that such an article should not have been published, without giving me an opportunity to enlighten you in regard to the matters referred to therein, as to which you confess ignorance.

I did not come to this country as the emissary or agent of any one. I have been connected with Baker & Co., Inc., and the American Platinum Works, since their organization and no German capital was ever employed directly or indirectly in their expansion, unless a former one-fifth interest in their capital stock can be so regarded.

As to the Draper incident, which you feature so prominently in your article, I would state that my advice was not asked in the matter, nor offered, nor had I at that time even met Mr. Summers.

I have lived in this country for over twenty-five years, have been an American citizen for many years and yield to no one in my admiration of our laws and institutions. I have never served in any official capacity to our Government, and, like any other loyal American citizen, have answered in the most conscientious manner only such questions as were put before me, thus endeavoring to give to our Government the benefit of any special knowledge I might possess in regard to platinum.

I have nothing to fear or conceal. My record is well known to our Government, and I demand only justice from my fellow-citizens.

CHARLES ENGELHARD

New York.

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your editorial entitled "Germany's Finger in the Platinum Pie," which appeared in your issue of August 15, in so far as it suggests that the undersigned company has been or is subject to German influence, is unjust, misleading and directly contrary to facts. None of our stock is now owned, or since nearly a year previous to our entry into the war, has been owned by any German or ally of Germany, nor does any enemy or ally of an enemy influence or control our management directly or indirectly in the slightest degree.

At no time in our history has any German interest owned more than one-fifth of our stock, nor did such stock exercise any special influence in our management, nor has German capital or credit contributed in any other respect to our expansion or growth. On the other hand, we include among our largest stockholders Mr. Charles W. Baker and the Estate of Mr. Cyrus O. Baker, of Newark, the well-known English firm of Johnson, Matthey & Co., Ltd., and the French firm now Quennessen, de Belmont, Legendre & Co. The Bakers are of old American stock; Johnson, Matthey & Co., Ltd., are the direct representatives of the British Government as regards platinum, and needless to say would not be associated with any pro-German interests in this country.

BAKER & COMPANY, INC.

Newark, N. J.

Dye-Stuff Symposium at Cleveland

To the Editor of Chemical & Metallurgical Engineering

SIR:—At the American Chemical Society meeting in Cleveland there will be a dye-stuff symposium on Tuesday at 2 o'clock, September 10, which will also continue over into Wednesday morning.

All phases of the chemistry of dye-stuffs will be under discussion and a number of papers by experts in this line will be presented. The meeting will also be thrown open to general discussion.

It is expected that out of this initial dye-stuff symposium there will arise regular meetings of those interested in the chemistry of dye-stuffs at the conventions of the American Chemical Society for the purpose of discussing and encouraging the development of the chemistry of these materials.

As this phase of the dye-stuff industry is so essential to its ultimate development, we are asking hearty coöperation of all interested.

R. NORRIS SHREVE,
Chairman, Dye-Stuff Symposium

Calco Chemical Company,
Bound Brook, N. J.

Western Chemical and Metallurgical Field

American Zinc Institute.

OVER 150 men interested in the mining and smelting of zinc met in St. Louis July 29 to consider ways and means of bettering the economic condition of the metal through their coöperative action. The result of this conference, said to be the first in the history of zinc mining, was the appointment of a committee to effect the permanent organization of the American Zinc Institute. This committee on organization consists of the following men, well known to the industry: Victor Rakowsky, Joplin, Mo.; J. L. Bruce, Butte and Superior Mining Co., Butte, Mont.; E. H. Wolff, Illinois Zinc Co., Peru, Ill.; A. B. McMillan, Edgar Zinc Co., St. Louis, Mo.; Chas. T. Orr, Athletic Mining and Spelter Co., Webb City, Mo.; A. P. Cobb, New Jersey Zinc Co., New York City; and W. F. Rossman, American Zinc, Lead and Smelting Co., St. Louis, Mo.

The recent history of the zinc market is well known It was the first common metal to be demanded in unusual quantities by our allies, but over a year ago the ready expansion of American mines and mills changed an excess demand into an overproduction, and the price rapidly fell. The low point of 6¢ was higher than the normal pre-war average of 5½, but increasing commodity process caused sharp curtailment by producers.

The problems awaiting solution by the American Zinc Institute may be realized when one considers the difficulties which the American industry are now weathering, despite the embargo on ore shipments from abroad and the exclusion of the Mexican ore by refusing it railway equipment for transportation from ports of entry. With the field absolutely pre-empted there is today but 60 per cent of the present live distilling capacity operating. Prospective American exporters cannot realize too early that when transportation is normalized the severest competition will have to be met in foreign markets. At present it may be easier to exact a better price for metal than to use real brains to lower its cost; but after the war the decisions of the War Industries Board will have small interest to the Spaniard who asks for specifications. If it is to succeed, the energies of the Institute may well be diverted from the monopolistic fixation of prices and expended on the larger labors of research for increased mining and metallurgical efficiency and for new uses for the metal, and to acquire and disseminate among their membership and the general public statistical and other information as to production, costs, and uses.

Other metallurgical and chemical industries may well profit by the experience in zinc. The soaring price of a war bride has killed that one market absolutely necessary for continued operation, the steady, small-lot, home consumption. If copper, steel, lumber and others follow the example of zinc, the most drastic price cutting will be necessary at the war's end in order to re-educate the consumers to the old-fashioned uses of common commodities.

Prices Fixed for Sheet and Plate Zinc

The President has approved an agreement made between the producers of sheet and plate zinc and the Price Fixing Committee of the War Industries Board (after investigations by this committee in conjunction with the Federal Trade Commission as to the cost of production) that the maximum base price of fourteen cents per pound f.o.b. plant for plate zinc, and fifteen cents per pound f.o.b. plant for sheet zinc, shall be continued on deliveries from Sept. 1, 1918, to Jan. 1, 1919, subject to the usual trade discounts and extras or differentials that were in effect Feb. 13, 1918. These discounts and extras shall be effective on all contracts executed between Feb. 13, 1918, to Jan. 1, 1919. Sheet zinc shall be considered as including all gages of one-eighth inch thickness and less and plate zinc as including all gages thicker.

The conditions are, as formerly: First, that the producers of plate and sheet zinc will not reduce the wages now being paid; second, they will sell to the Allies, to the public, and to the Government at the same price; third, that they will take the necessary measures, under the direction of the War Industries Board, in the distribution of plate and sheet zinc to prevent it from falling into the hands of speculators who might increase the price to the public; and fourth, that they pledge themselves to exert every effort necessary to keep up the production of plate and sheet zinc so as to insure an adequate supply as long as the war lasts.

Work Suspended on Muscle Shoals Hydro-electric Power Project

The War Department after consultation with the War Industries Board has ordered the suspension of work on the dam and other construction for the hydro-electric power project at Muscle Shoals, Alabama. In making this statement to the Washington correspondent of CHEMICAL & METALLURGICAL ENGINEERING, Benedict Crowell, assistant secretary of war, pointed out that no stoppage of work on the building of the nitrate plant at Muscle Shoals is in contemplation nor is there any contemplation of stoppage of work at the Cincinnati, Toledo and other plants. In fact there are estimates obtainable in Washington that the nitrate plant at Muscle Shoals will be placed in production this year.

While the work on the hydro-electric development at Muscle Shoals is announced as being suspended temporarily, it is nevertheless the belief in Washington that this work has been suspended for the period of the war. Three years would be required to complete this work and it is plainly stated at the War Department that in view of this fact the work is of a non-essential character. In other words, the belief is entertained in Washington that the war will be over before this particular power plant could be placed in production.

The decision to abandon the Muscle Shoals hydro-electric plant came as the result of a request to the War Industries Board that this project be placed on the list for priority as an essential undertaking but the Board held that the labor and material being used there and in contemplation are urgently required to meet more immediate war demands. In this view the War Department has concurred.

Emergency Bill in Congress for Federal Control of Power Resources

T. W. SIMS, chairman of the House committee on interstate and foreign commerce, has introduced in the House of Representatives a bill "to provide further for the national security and defense and for the more effective prosecution of the war by furnishing means for the better utilization of the existing sources of electrical and mechanical power and for the development of new sources of such power." The bill provides the sum of $150,000 for administrative expenses and provides the sum of $200,000,000 for the purchase and building of power plants.

The proposed legislation is to be known as the emergency power act. It is not to be confused with the water-power bill now pending in the House of Representatives and will not be considered in connection with that bill, which is all ready on the floor of the House, while the emergency power act has but just been referred to the committee. Hearings on the emergency power act were begun before the House interstate and foreign commerce committee on Aug. 23. The War Industries Board, the Treasury Department and the Shipping Board served notice on the committee that it was desired that representatives of these governmental agencies should testify at the hearings.

In making the bill public, Representative Sims issued a statement in part as follows:

> We are facing a power shortage which is and for some time past has been acute and is hampering our progress on war production. So this measure authorizes the President to erect power stations near the coal mines and at other points where he may deem them necessary, or to extend financial aid to persons or corporations about to do so, and therefore desiring to secure results of tremendous, immediate and inestimable value to America. It is considered necessary by representatives of the administration, by representatives of the great power companies and by economists who attacked the problem from various viewpoints, and is indorsed by all of them.
>
> This bill must not be misunderstood as in any wise taking the place of the water-power bill now before the House. That is in its nature a peace-time measure, and the provisions of the two do not conflict. The plans are to confer upon the President all necessary power to deal with the urgent power situation properly and effectively and to place at his disposal sufficient funds with which to assure adequate operation. The bill concerns:
>
> 1. Increased production of power available for war industries and shipyards.
> 2. Economy in the use of fuel.
> 3. Reduction in the railroad freight load, especially in the fuel load.
> 4. Increased production of metallurgical coke, toluol, ammoniacal liquor, all recovered from coal.

The bill grants sweeping authority to the President and includes penalties of imprisonment or fine or both for any who knowingly neglect or refuse to comply with any order or requisition made by the President or any officer or agency designated or created under the act.

New Electric Smelting Furnaces in Sweden.—Having doubled its capital and made it $724,000 the Aktiebolaget Porjus Smältverks proposes to build two electric smelting furnaces this summer. The company has already three furnaces in operation. The company's power is secured from the Porjus waterfall. It expects to manufacture 20,000 metric tons of pig iron each year. —*Consular Reports.*

Electric Furnace Manufacturers Confer on War Problems

ELECTRIC furnace manufacturers who are organized under the name of the Electric Furnace Industries War Service Committee, met in New York City on Aug. 20 to consider what steps should be taken for their welfare, in view of the possibility of action by the War Industries Committee curtailing construction of new plants for steel castings. As outlined in CHEMICAL & METALLURGICAL ENGINEERING, Aug. 15, page 171, the electric furnace industry is confronted with the fact that the War Industries Board may find it necessary to grant no new permits for electric steel casting plants, due to the fact that there is already ample casting capacity.

The Executive Committee of the organization, comprising G. H. Clamer, F. N. Castle, C. P. Fletcher and F. J. Ryan, discussed the entire situation with the following members of the association: C. H. Booth, F. W. Brooke, H. A. DeFries, C. H. VomBaur, T. F. Baily and D. D. Miller. Although considerable time was devoted to a discussion of the electrode situation, the association properly concluded that this phase of the matter was not of immediate concern to electric furnace manufacturers, but that the controlling factor was whether or not there is already an ample capacity in the country for steel castings. Being in agreement on this point the meeting passed a resolution to the effect that the Executive Committee of the organization should confer with the Steel Division of the War Industries Board to ascertain whether or not there is now a shortage of capacity for steel castings and whether new capacity is essential. The Executive Committee is to report its findings to the members of the organization and further action is to be taken after this report is received. All of the furnace manufacturers are in agreement to abandon further efforts to establish new electric steel casting plants if the War Industries Board satisfies them that there is now ample supply for all needs.

Ordnance Board on Metallurgical Matters

In order to assure the more complete coordination of the various Ordnance Departmental activities along metallurgical lines, it has been decided to establish a Board on Metallurgical Matters. The appointment of this board will also assure the complete coördination of similar activities of the different divisions of the War Department and the War Industries Board.

The personnel of the board is as follows: Dr. G. W. Sargent, Engineering Division, chairman; Lt. Col. W. P. Barba, Production Division; Major A. E. White, Inspection Division, representing the Ordnance Department; Lt. Col. F. B. Richards, of the office of the Assistant Secretary of War; Mr. L. L. Summers, representing the War Industries Board, and Mr. William H. Smith, representing the manufacturers.

The board will act not only for the various sections of the Ordnance Department but also in connection with the manufacturers working for and with the department in the production of war material, and will gather the most recent and complete information on all metallurgical products.

Disposition of Chemists in the Army

AS A RESULT af a letter from the Adjudant General of the Army, dated May 28, 1918, 1749 chemists in the army have been reported on. Of these the report of actions to August 1, 1918, shows that 281 were ordered to remain with their military organization because they were already performing chemical duties; 34 were requested to remain with their military organization because they were more useful in the military work which they were doing; 12 were furloughed back to industry; 165 were not chemists in the true sense of the word and were, therefore, ordered back to the line; and 1294 are now placed in actual chemical work. There were being held for further investigation of their qualifications on August 1, 1918, 432 men. The remaining 23 men were unavailable for transfer, because they had already received their overseas orders.

The 1294 men, who would otherwise be serving in a purely military capacity and whose chemical training is now being utilized in chemical work, have, therefore, been saved from waste. Each case has been considered individually, the man's qualifications and experience have been studied with care, the needs of the Government plants and bureaus have been considered with equal care, and each man has been assigned to the position for which his training and qualifications seem to fit him best. Undoubtedly, there have been some cases in which square pegs have been fitted into round holes, but, on the whole, it is felt that the adjustments have been made as well as could be expected under the circumstances. Where readjustment is necessary, subsequent action will be taken.

Enemy Patent Licenses Issued by Federal Trade Commission

Following is a complete list of enemy patent licenses issued by the Federal Trade Commission. It is significant of the activity of the German people along chemical lines to note that over 80 per cent of the licenses granted are for patented chemical processes and products not hitherto used or produced by American chemists.

Patent Licenses Issued

Non-exclusive. The Dermatological Research Laboratories, 1818 Lombard St., Philadelphia, Pa. Arsphenamine, Nov. 26, 1917. Neo-arsphenamine, Mar. 4, 1918.

Non-exclusive. Takamine Laboratory, Inc., 120 Broadway, New York City. Arsphenamine, Nov. 26, 1917. Neo-arsphenamine, Mar. 4, 1918.

Non-exclusive. Farbwerke-Hoechst Company, 122 Hudson St., New York City. Arsphenamine, Nov. 26, 1917. Neo-arsphenamine, Mar. 4, 1918. (License cancelled and license issued to H. A. Metz Laboratories, Inc., in its place.)

Non-exclusive. H. A. Metz Laboratories, Inc., 122 Hudson St., New York City. Arsphenamine, July 19, 1918. Neo-arsphenamine, July 19, 1918.

Non-exclusive. Diarsenol Company, Inc., 475 Ellicott Square, Buffalo, N. Y. (Factories in Toronto, Canada.) Arsphenamine, Jan. 12, 1918. Neo-arsphenamine, Mar. 4, 1918.

Non-exclusive. Farbwerke-Hoechst Company, 122 Hudson St., New York City. Procaine, Dec. 17, 1917. (License canceled and license issued to H. A. Metz Laboratories, Inc., in its place.)

Non-exclusive. H. A. Metz Laboratories, Inc., 122 Hudson St., New York City. Procaine, July 19, 1918.

Non-exclusive. Rector Chemical Company, Inc., 2 Rector St., New York City. Procaine, Dec. 17, 1917.

Non-exclusive. The Abbott Laboratories, 4739-57 Ravenswood Ave., Chicago, Ill. Barbital, Dec. 17, 1917.

Non-exclusive. The Abbott Laboratories, 4739-57 Ravenswood Ave., Chicago, Ill. Procaine, Jan. 10, 1918.

Non-exclusive. The Abbott Laboratories, 4739-57 Ravenswood Ave., Chicago, Ill. Phenyl Cinchoninic Acid, Mar. 23, 1918.

Exclusive. Pacific Flush Tank Company, 4241-43 Ravenswood Ave., Chicago, Ill. Sewage Treatment Apparatus, Dec. 17, 1917. (Imhoff Tank.)

Exclusive. Lembcke, von Bernuth Company, Inc., 171 Madison Ave., New York City, Rueping Process of Treating Timber, Jan. 17, 1918.

Exclusive. Hoevel Manufacturing Corporation, 50 Church St., New York City, Sand Blast Machine, Feb. 18, 1918.

Non-exclusive. Calco Chemical Company, Inc., Bound Brook, N. J. Procaine, Feb. 18, 1918.

Non-exclusive. French Battery & Carbon Company, Madison, Wis. Depolarizer for Galvanic Cells, Feb. 18, 1918.

Non-exclusive. Antoine Chiris Company, 18 Platt St., New York City. Barbital, Mar. 11, 1918.

Non-exclusive. New Process Metals Co., Inc., 50 E. 41st St., New York City. Pyrophoric Alloy, Pyrophoric Mass, Mar. 30, 1918.

Non-exclusive. Pfanstiehl Company, Inc., North Chicago, Ill. Pyrophoric Alloy, Mar. 30, 1918.

Non-exclusive. E. I. duPont de Nemours & Co., Wilmington, Del. Anthracene, Indigo, Sulphur and Azo Dyes, Jan. 21, 1918.

Non-exclusive. Albert B. Moses, 909 Eighth Ave., Seattle, Wash. Artificial Milk, Apr. 8, 1918.

Exclusive. F. L. Smith & Co., 50 Church St., New York City. Ball-Mill, Apr. 8, 1918.

Non-exclusive. E. C. Klipstein & Sons Company, 644 Greenwich St., New York City. Hydrosulfites (Dyes), Apr. 8, 1918.

Non-exclusive. The Hagan Corporation, People's Bank Building, Fourth Ave. and Wood St., Pittsburgh, Pa. Suction Device for Dust-laden Air, May 3, 1918.

Exclusive. American Parlograph Corporation, 123 Liberty St., New York City. Talking Machine, May 7, 1918.

Non-exclusive. National Aniline & Chemical Co., Inc., 21 Burling Slip, New York City. Anthracene, Indigo, Sulphur and Azo Dyes, June 28, 1918.

Non-exclusive. Robert Reiner Importing Company, Gregory Ave. and Hackensack Plank Road, Weehawken, N. J. Embroidering Machines, July 10, 1918.

Non-exclusive. The Stearns-Roger Manufacturing Company, 1720 California St., Denver, Colo. Cellular Drying Apparatus, July 16, 1918.

Non-exclusive. Merrimac Chemical Company, 148 State St., Boston, Mass. Hydrosulfites (Dyes), July 16, 1918.

Non-exclusive. General Ceramics Company, 50 Church St., New York City. Absorption and Reaction Tower for Acids, July 19, 1918.

Trade-Marks

Exclusive. Lehn & Fink, 120 William St., New York City. Pebeco (Tooth-Paste), Dec. 17, 1917.

Exclusive. The Anchor Packing Company, Lafayette Building, Philadelphia. Tauril, Feb. 19, 1918.

Non-exclusive. The Abbott Laboratories, 4739-57 Ravenswood Ave., Chicago, Ill. Veronal, Dec. 17, 1917.

Sulphur Syndicate in Sicily

The report that accompanies the draft of the bill for granting an extension of 12 years to the syndicate interested in the sulphur production of Sicily intimates that such extension has been asked for in order to protect the principal industry of Sicily, which is confronted with greater foreign competition at a time when not only larger quantities of the product are needed for explosives but labor for working the mines is scarce. It is believed that the intensifying of the Japanese production, the discovery of deposits in northern Africa, and the very considerable American output constitute a serious menace to the native industry. In view of the situation, therefore, it is believed that by extending for 12 years the rights of the syndicate, whose special work it is to combine and regulate the efforts of the individual producers, efficient means will be adopted for meeting the competition of the future.—*Canadian Bulletin of Trade and Commerce.*

War Department Orders New Census of Chemists

THE following open letter has been addressed to the chemists of the United States by Maj. Gen. William L. Sibert, Director of Chemical Warfare Service. The communication pertains to a new census of chemists in the United States which the War Department has found necessary in view of the changes that have occurred since the census taken at the beginning of the war by Dr. Charles L. Parsons, Chief Chemist of the United States Bureau of Mines and Secretary of the American Chemical Society. All chemists in the United States will receive a questionnaire, which we reproduce herewith, and they should be at special pains to make a prompt return so that the War Department can be in possession of the knowledge which it now finds necessary. By returning the blank properly executed, no one binds himself in any way to any service of the Government, but he will put the War Department in possession of the necessary knowledge to enable it to turn to the chemists of the country for aid or advice.

WAR DEPARTMENT
CHEMICAL WARFARE SERVICE
WASHINGTON, D. C.

September 1, 1918.

TO THE CHEMISTS OF THE UNITED STATES:

This is a chemical war; therefore the War Department must have immediately available all possible information regarding chemical materials and chemical man power. Of these two essential elements chemical man power has so far received less attention. The census of American chemists made by the American Chemical Society in 1917 has been of great assistance to the War Department. Without it the present state of progress of the United States in chemical warfare would have been impossible of attainment.

However, during the same period conditions have undergone rapid and radical changes. The old census, excellent as it was, is no longer completely adequate. With the organization of the Chemical Warfare Service as an independent branch of the War Department, unifying all the elements of chemical warfare, it is obvious that the War Department must have its own set of records on a matter so vital to its own success. Moreover, these records must contain information which a short time ago was apparently of little importance. The new census must be made primarily from the viewpoint of the military status of chemists.

The importance of a prompt return of the census blank, properly filled out, by every chemist of the country cannot be overstated. American chemists are presented at this moment with one of the greatest opportunities to serve their country by the simple process of answering this questionnaire with all possible speed.

(Seal) (sgd.) WILLIAM L. SIBERT,
Major General, U. S. A.,
Director of Chemical Warfare Service.

QUESTIONNAIRE

Date.....

Name .....
(Last) (First) (Middle)

Present address .....

Permanent address .....

I. GENERAL

1. Born (a) Date ..... (b) Place.....
2. Age ..... 3. Place of birth (a) of father.....
..... (b) of mother ..... 4. Are you an American citizen?..... 5. If naturalized, give date ..... 6. Are you married?.....
7. Is your wife living? ..... 8. How many people are dependent upon you (a) wholly?.....
(b) partially? .....

II. TRAINING

9. Give the names of the schools, colleges, universities, graduate schools, or technical schools, which you have attended, with dates of attendance, courses pursued, and degrees granted.

Institutions	Dates	Courses pursued	Degree

10. State any other training you have had.....
11. State fully the courses of study in which you have specialized .....
12. What foreign languages do you (a) speak.....
..... (b) read? ..... (c) write .....
13. Of what technical societies are you a member?
.....

III. PRACTICAL EXPERIENCE

14. In what foreign countries have you had experience and how much? .....
15. How many years of continuous experience have you had? .....
(a) Industrial ..... (b) Teaching .....
(c) Other .....
16. What experience have you had along executive and administrative lines? .....
17. State in detail your duties in your various positions. .....

From—To	Employer	Title	Nature of work	Salary (Statement optional and confidential)

18. Publications.

Title	Publisher	Date

19. State specifically the kind of work you do best
.....
20. In the present emergency how and where, in your opinion, could you be of most service to your country?
.....

IV. SERVICE

21. Do you desire to enter the service of the United States at once (a) in a civilian capacity?.....
(b) in a military capacity? .....
Note. If you answer this question in the affirmative, answer the rest of the questions in this section insofar as they apply to your case: Otherwise, skip to section V.
22. What rank (or salary, if you desire a civilian appointment) would you accept? .....
23. What has been your total military experience?
.....
24. Are you registered in the draft? .....
25. What is your Order Number? .....
26. What is your Serial Number? .....
27. Have you received the draft questionnaire?.....
28. How have you been classified?.....
29. Give names and addresses of three or four responsible persons (not relatives) or send letters of recommendation herewith.

Name	Address

V. MISCELLANEOUS

30. State anything else, which will aid us, or which you want us to know, which is not covered by the questions on this folder. (Answer this question last.)
.....

Please re-read this whole questionnaire and sign below.

Signature .....

Chemical Warfare Service, National Army

An Account of the Inception and Development of the Chemist's Part in Military Operations—Organization of the Service—Commissioned Personnel Here and Overseas

GENERAL Order No. 62 of the War Department dated June 28, 1918, will always have special significance to the chemists of the United States because therein the Secretary of War, at the direction of the President, organized the Chemical Warfare Service of the National Army.

Developments by the Bureau of Mines

The evolution of the Chemical Warfare Service is interesting because it had its inception in a branch of the Government not concerned with warfare, namely, the Bureau of Mines of the Department of the Interior. On account of the familiarity of the Bureau with noxious gases in mines, it was able to make an early start on the important work of gas warfare at a time when the War Department was deluged with other important problems. The result is that we have heard no criticism of delay in the gas warfare work such as has been directed at other branches. An important feature of the work of the Bureau was the wonderful coöperation which it secured from the leading chemists of the country who responded willingly and promptly to the call. This enabled the Bureau to turn over to the War Department a complete, well articulated organization of more than 1,800 chemists which had accomplished great things prior to being transferred.

Early in February of 1917, when war between the United States and the Central Powers seemed inevitable, the Bureau of Mines called the attention of the War Department to the already existing technical organization in the Bureau for the study of poisonous gases in mines, gas masks etc., and offered the facilities of the Bureau to the War Department for this work. A meeting was arranged between representatives of the Bureau and the War College. At this conference the War Department enthusiastically accepted the offer of the Bureau of Mines and agreed to support the work in every way possible.

The Director of the Bureau of Mines immediately directed investigations of these war problems, and until July 1, 1917, carried the work along with funds of the Bureau. The first work was done on the development of gas masks. On July 1, 1917, the staff consisted of fifty paid investigators and the work had expanded from gas-mask research to the study of poison gases and chemical warfare appliances for offensive purposes.

Coöperation of Universities and Research Organizations

In order to enlist the coöperation of the universities and research institutions in the United States, personal visits were made to practically all of the important ones. The response was most gratifying. Up to the present time some extremely important work has come out of these universities and institutions. On April 6, 1917, the following committee on gases used in warfare was formed by the National Research Council for the purpose of coöperating with the Bureau of Mines in connection with this work:

Van. H. Manning, Chairman.	Director, U. S. Bureau of Mines.
George E. Hale, (Ex-Officio) National Research Council.	Director, Mt. Wilson Solar Observatory.
Lt. Col. R. A. Millikan, (Ex-Officio) National Research Council	Science and Research Division, Signal Corps.
Carl L. Alsberg	Chief, Bureau of Chemistry, U. S. Department of Agriculture.
Maj. Earl J. Atkisson	Corps of Engineers, U. S. A.
Lt. Col. Marston T. Bogert.	Chemical Service, N. A.
Lt. Col. Bradley Dewey	Gas Defense Service, Surgeon General's Office.
A. H. Marks	Director, Gas Service, U. S. A.
Lieut. Joseph R. Phelps	P. A. Surgeon, Bureau of Medicine and Surgery, U. S. N.
Lt. Col. Earl J. W. Ragsdale.	Bureau of Ordnance, U. S. A.
Lieut. T. W. Wilkinson	Bureau of Ordnance, U. S. N.

This committee has worked in hearty coöperation with the Bureau of Mines.

Until August, 1917, the Bureau of Mines also supervised the construction of gas masks.

On November 7, 1917, Secretary Lane appointed the following Advisory Board to the Director of the Bureau of Mines on war problems: Dr. Wm. H. Nichols, Prof. E. C. Franklin, Dr. C. L. Parsons, Mr. Wm. Hoskins, Prof. H. P. Talbot, Dr. F. P. Venable, Dr. Ira Remsen, Prof. T. W. Richards.

Since that date the Board acted in an advisory capacity to the Director on the gas work, both as individuals and as a body. The Board first met on Monday, December 17, 1917, and visited the laboratories and consulted with the research staff. They were also given a demonstration of the work in progress and full reports were made to the Board by all section chiefs. A second meeting was held on May 15 and 16, 1918, when the work was again reviewed.

It was finally decided that the Bureau of Mines would remain as a research organization, making recommendations to the Army and Navy regarding the kinds of masks and nature of gases to be used, together with their method of manufacture, and that the construction of the mask proper should be transferred to the Surgeon General's Office of the Army. The organization working for the Bureau of Mines was turned over to this department of the Army and formed the nucleus of the present huge organization working on the construction of gas masks and other appliances for gas defense.

On September 15, 1917, many of the experimenters working for the Bureau of Mines on war gas problems moved into the present headquarters of the organization at the American University, on the outskirts of Washington. The University authorities turned over the use of two large buildings at this place, rent free, but with the

proviso that some of the alterations and additions, necessary for the proper conduct of the work, would be permanent and become the property of the University after the war was over. The lease of the buildings and grounds of the University extends to a period two years from July 1, 1917, or during the war if it should extend beyond the two-year period.

Chemical Service Section Organized in National Army

In December, 1917, a chemical corps was established in the National Army and a part of the unit sent to France. This unit is composed largely of men trained in the Bureau of Mines' organization. In December, also, a staff of chemical engineers, working for the research organization of the Bureau of Mines, developing processes for manufacturing gases, was transferred to the Bureau of Ordnance of the War Department and formed the nucleus of the present organization, building huge plants for the manufacture of poison gases. Another organization, which had its inception under the Bureau of Mines, and has for its head a man who worked for the Bureau and reecived his training on noxious gas methods, is the proving-ground unit of the War Department, established at Gunpowder Neck, for actually trying out gases on an artillery scale after they have been studied by the research organization.

The personnel of the research organization also included a group working on chemical warfare devices. These substances include aëroplane gas bombs, signal lights, smoke screens to screen merchant ships from enemy submarines, gas shells, incendiary shells, gas bombs, trench projectors for firing gas bombs, flaming guns etc., and important recommendations have gone from the research organization covering such materials which have been adopted by departments of the Army and Navy interested and put into production.

In recapitulating the work of the Bureau of Mines it may be said that, by inaugurating the gas warfare program with the hearty support of the Army and Navy departments, the National Research Council, state educational, and private institutions, we are undoubtedly months ahead of where we otherwise would have been; that our soldiers have gas masks, and will have gases with which to combat the Germans; further, that the developments in gas mask manufacture by the Surgeon General's Office of the Army, in gas manufacture and gas proving-ground tests by the Bureau of Ordnance, and in the chemical warfare program of the Navy, including the use of smoke screens, shells, toxic gases etc., are the results from this experimental work.

The scientific achievements of the Bureau of Mines have been many, but the results cannot be given at this time for reasons that are obvious. It is sufficient to say that due to the energy of the research organization of the Bureau of Mines, the large scale production of toxic gases is far ahead of the supply of shells.

The Advisory Chemical Board said of the work being done by the Bureau of Mines: "The efficiency, success, fine spirit, and enthusiasm under the leadership of the Bureau of Mines is a matter upon which we wish to congratulate the Bureau, as well as upon the splendid group of unselfish, self-sacrificing men who carried on this arduous and dangerous work."

At that time before the transfer of the work the Chemical Board added: "The organization is complex and delicate but well articulated and working with an efficiency and enthusiasm which has impressed us greatly."

Work Coördinated and Consolidated by the President

As the war progressed, it became apparent that, in the interest of economy and more efficient concentration of the work, certain bureaus and agencies should be coordinated or consolidated. Accordingly, the experiment station at American University, which had been under the control of the Bureau of Mines, was transferred to the War Department, in which connection the following correspondence passed between Secretary of War Baker, the President and Director Manning of the Bureau.

WAR DEPARTMENT
WASHINGTON

June 25, 1918.

My dear Mr. President:

In connection with the proposed transfer of the chemical section at American University from the Bureau of Mines to the newly constituted and consolidated Gas Service of the War Department, which you are considering, I am specially concerned to have you know how much the War Department appreciates the splendid services which have been rendered to the country and to the Army by the Department of the Interior, and especially by the Bureau of Mines under the direction of Dr. Manning. In the early days of preparation and organization, Dr. Manning's contact with scientific men throughout the country was indispensably valuable. He was able to summon from the universities and the technical laboratories of the country men of the highest quality and to inspire them with enthusiastic zeal in attacking new and difficult problems which had to be solved with the utmost speed. I do not see how the work could have been better done than he did it, and the present suggestion that the section now pass under the direction and control of the War Department grows out of the fact that the whole subject of gas warfare has assumed a fresh pressure and intensity, and the director of it must have the widest control so as to be able to use the resources at his command in the most effective way possible. The proposal does not involve the disruption of the fine group of scientific men Dr. Manning has brought together, but merely their transfer to General Sibert's direction.

Respectfully yours,

The President. (Signed) Newton D. Baker.

THE WHITE HOUSE
WASHINGTON

26 June, 1918

My dear Dr. Manning:

I have had before me for some days the question presented by the Secretary of War involving the transfer of the chemical section established by you at the American University from the Bureau of Mines to the newly organized Division of Gas Warfare in which the War Department is now concentrating all the various facilities for offensive and defensive gas operations. I am satisfied that a more efficient organization can be effected by having these various activities under one direction and control, and my hesitation about acting in the matter has grown only out of a reluctance to take away from the Bureau of Mines a piece of work which thus far it has so effectively performed. The Secretary of War has assured me of his own recognition of the splendid work you have been able to do, and I am taking the liberty of enclosing a letter which I have received from him, in order that you may see how fully the War Department recognizes the value of the services.

I am to-day signing the order directing the transfer. I want, however, to express to you my own appreciation of the fine and helpful piece of work which you have done, and to say that this sort of team work by the bureaus outside of the direct war-making agency

is one of the cheering and gratifying evidences of the way our official forces are inspired by the presence of a great national task.

Cordially yours,
(Signed) Woodrow Wilson.

Dr. Van. H. Manning,
Chief, Bureau of Mines,
Department of the Interior.

Formal Organization of the New Service

As stated in the opening paragraph, the War Department finally ordered the organization of the Chemical Warfare Service, National Army, to remain in full force and effect during the continuation of the present war and for six months after the termination thereof.

The rank, pay, and allowances of the enlisted men of the Chemical Warfare Service, National Army, are the same as now authorized for the corresponding grades in the Corps of Engineers.

Head to Be Director

The head of the Chemical Warfare Service, National Army, is known as the Director of the Chemical Warfare Service, and, under the direction of the Secretary of War he is charged with the duty of operating and maintaining or supervising the operation and maintenance of all plants engaged in the investigation, manufacture, or production of toxic gases, gas-defense appliances, the filling of gas shells, and proving grounds utilized in connection therewith and the necessary research connected with gas warfare. He also exercises full, complete, and exclusive jurisdiction and control over the manufacture and production of toxic gases, gas-defense appliances, including gas-shell filling plants and proving grounds utilized in connection therewith, and all investigation and research work in connection with gas warfare.

Functions of Subdivisions of Chemical Warfare Service

The functions of the various divisions and branches are as follows:

Overseas Division.—This division includes personnel assigned to all divisions and corps and army headquarters in addition to those required for the supply of material in the field in France.

Research Division.—Charged with research into all matters pertaining to gas warfare.

Development Division.—For the development of material received from the Research Division to the point where it may be turned over for proving.

Proving Division.—Charged with the duty of proving the efficiency of material under field condition.

Gas Defense Production Division.—The production of material such as gas masks for use in the defensive.

Gas Offense Production Division.—The production of gas, containers and other material for use in offensive gas warfare.

Functions of Sections in Administration Bureau

Records.—The recording and filing of all documents and handling mail and correspondence.

Personnel.—The procurement, assignment, transfer and promotion of commissioned and enlisted personnel and the listing and employment of civilians.

Finance.—Preparation of estimates, allotments, accounts, contracts and purchases. Handle all fiscal affairs.

Auditing.—The audit of all fiscal accounts.

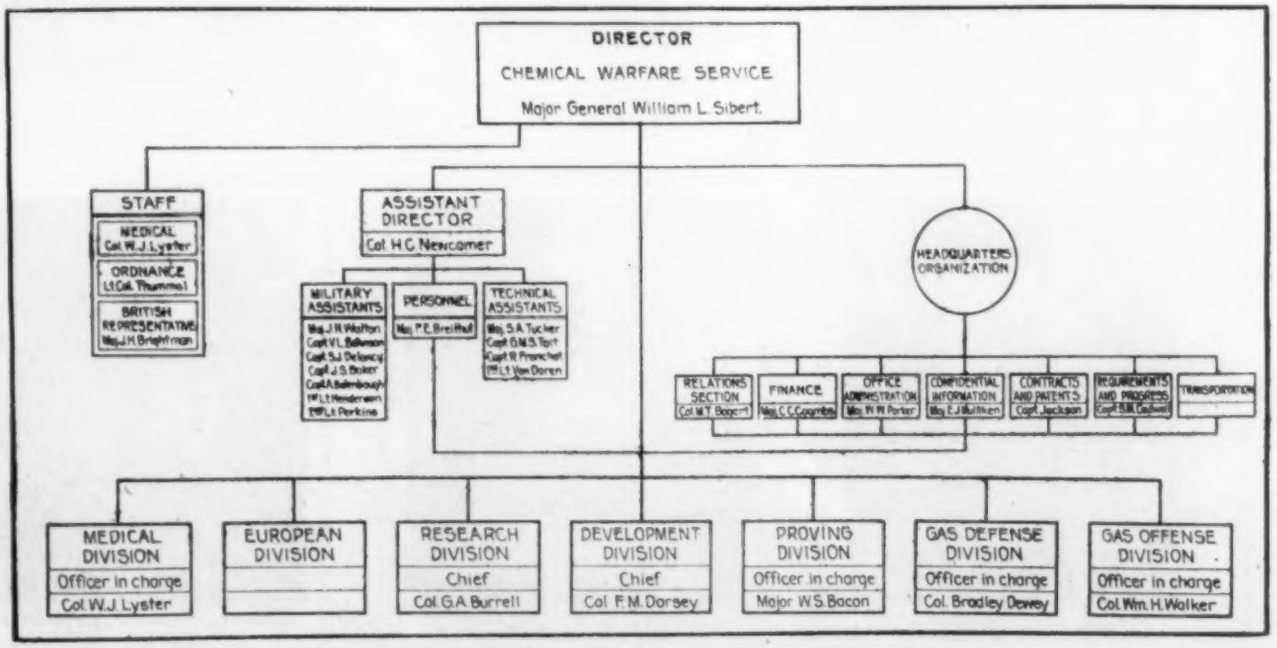
Transportation.—General supervision over transportation of personnel and material.

Property.—To be custodian of property returns required and to have charge of all property and means of transportation connected with headquarters.

Inspection.—To make such general and special inspections as may be required and to suggest methods for improvement in coördination between the various divisions and branches of the Chemical Warfare Service.

New Projects.—For the investigation of and recommendations concerning new projects.

Training.—Training of personnel.

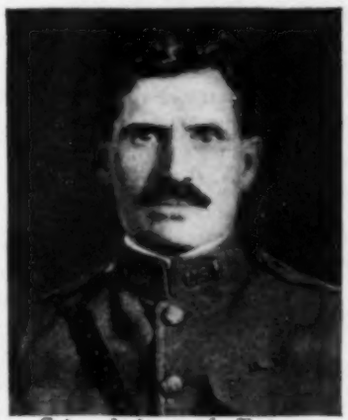


ORGANIZATION CHART, CHEMICAL WARFARE SERVICE, N. A.

Chemical Warfare Ser

Heads of Divisi

Colonel Raymond F. Bacon,
OVERSEAS DIVISION



Colonel Amos A. Fries,
OVERSEAS DIVISION

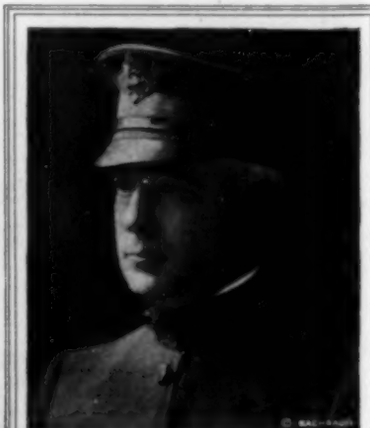
Colonel George A. Burrell
RESEARCH DIVISION

MAJOR GENERAL WILLIAM L. SIBERT,
U.S.A., DIRECTOR

Mr. Frank M. Dorsey,
DEVELOPMENT DIVISION

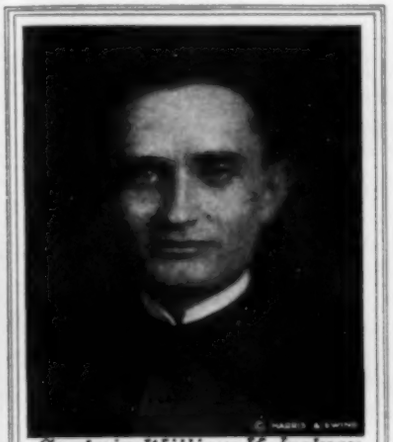
Major William S. Bacon,
PROVING DIVISION

Colonel Bradley Dewey,
GAS DEFENSE DIVISION

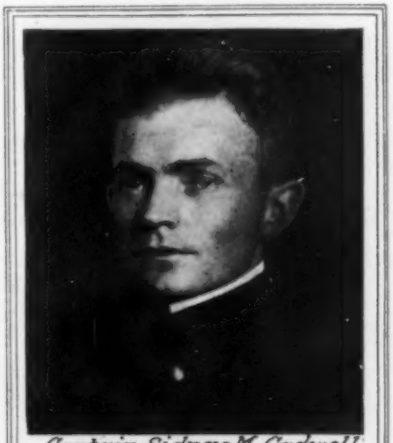


Colonel William H. Walker,
GAS OFFENSE DIVISION

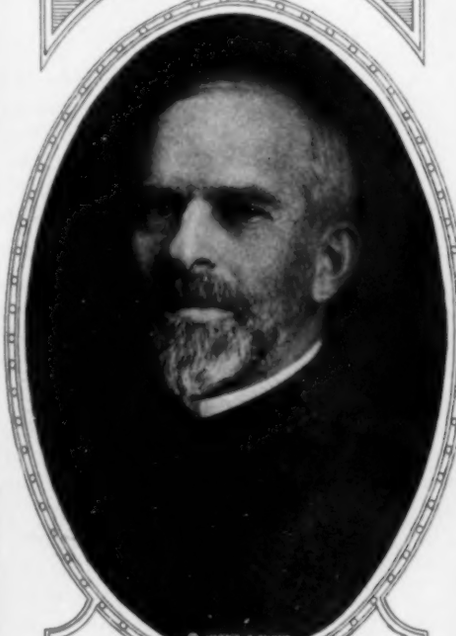
vice, National Army
ons and Sections



Captain William K. Jackson,
CONTRACTS AND PATENTS SECTION



Captain Sidney M. Cadwell,
REQUIREMENTS AND PROGRESS SECTION



COLONEL H. C. NEWCOMER,
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Major Victor Lehner,
ASSISTANT, RELATIONS SECTION

Major S. P. Mulliken,
CONFIDENTIAL INFORMATION SECTION

Colonel Marston T. Bogert
RELATIONS SECTION

Major F. E. Breithut,
PERSONNEL SECTION

Major Allen Rogers,
ASSISTANT, RELATIONS SECTION

Information.—To secure all information having a bearing on the Chemical Warfare Service.

OFFICERS AT THE HEADS OF DIVISIONS AND SECTIONS OF THE CHEMICAL WARFARE SERVICE, N. A.

Director, Major General William L. Sibert.

Assistant Director, Colonel H. C. Newcomer.*

Overseas Division, Colonel Raymond F. Bacon and Colonel Amos A. Fries.*

Research Division, Colonel George A. Burrell.

Development Division, Mr. Frank M. Dorsey.

Proving Division, Major William S. Bacon.

Production Division, Gas Defense, Colonel Bradley Dewey.

Production Division, Gas Offense, Colonel William H. Walker.

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Assistant:
Captain H. C. Bradley.

Ordnance Officer:
Lt. Col. C. B. Thummel, O. D.

Assistant:
Maj. C. S. Stevenson, C. W. S.

Representative of British Military Mission:
Maj. J. H. Brightman.

(2) Assistant Director, Chemical Warfare Service:
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To act for the Director in his absence, in charge of all military matters and new projects. Chairman, Board of Review.

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Capt. S. J. Delancy, C. W. S.
Capt. R. A. Baker, C. W. S.
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Sec. Lt. F. C. Perkins.

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Capt. G. W. S. Tait, C. W. S.
First Lt. L. Van Doren, C. W. S.
Mr. R. Franchot.

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Sec. Lt. B. W. Tipton, C. W. S.
Sec. Lt. W. D. Towler, C. W. S.

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Maj. Allen Rogers, C. W. S.
Maj. Samuel Avery, C. W. S.
Capt. C. V. Sheehan, C. W. S.
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Geo. S. Case.

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Sec. Lt. A. E. Case, C. W. S.

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Assistant:
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(7) *Finance Section.*
Major C. C. Coombs.
In charge of estimates, appropriations and allotments, of administrative audit of all disbursing accounts and of property. Member of Board of Review, C. W. S.

Assistant:
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Sec. Lt. J. A. Schon, C. W. S.

(9) *Confidential Information Section.*
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Assistant:
Sec. Lt. H. E. Moore, C. W. S.

(10) *Transportation Section.*
Officer in charge not yet selected.

Assistant:
Capt. H. R. Sharkey, C. W. S.

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COLONELS

Raymond F. Bacon — George A. Burrell
Marston T. Bogert — Bradley Dewey
Wm. H. Walker

*Have been nominated by the President for promotion to the rank of Brigadier General.

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Robt. C. Gowdy
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Burnett Wright

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Ashman, L. A.
Ashman, L. H.
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Bogue, Joseph C.
Boon, C. J.
Bramlet, Hubert B.
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Brodesser, R. E.
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Brown, Lester B.
Burt, R. A.
Cahill, Michail
Callemon, Clarence B.
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Clarke, Theodore
Clifford, C. W.
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Conohay, John R.
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Crossfield, Albert S.
Cuff, James B.
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Davis, George W.
Dunbar, Noel S.
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Eason, Harry M.
Eaton, Harry A. F.
Eldon, John A.
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Elsbey, Alden G.
Emory, Stuart R.
Esser, Alvah E.
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Fairchild, Tappon
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Fitzgerald, Heber D.
Fleming, Walter F.
Frederick, E. L.
Fuller, E. W.
Gage, Roscoe M.
Gaines, O. I.
Gibson, Richard
Gruse, William A.
Gurney, Harold P.
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Hayden, E. M.
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Heneage, Thomas H.
Hentz, William A.
McNeil, Winfield I.
McWilliams, John C.
MacConnell, John G.
MacDonald, Alexander D
MacNeill, N. M.
Mahlman, Osburn L.
Manning, Edwin C.
Mansur, Charles I.
Marshall, William D.
Martin, H. A.
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Mayham, Ray E.
Merrill, Leslie M.
Merryman, James R.
Mitchell, John H.
Moffitt, H. R.
Morawski, Frederick
Morgan, A. M.
Mott, John
Moulton, Paul B.
Mueller, William A.
Mulford, William J.
Murphy, Alfred L.
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Norlin, F. C.
Northrup, William C.
Norton, F. A.
O'Brein, Bernard
Ott, J. E.
Patterson, G. P.
Perkins, Granville A.
Perrett, G. St. J.
Phillips, George W.
Pierce, Edward T.
Pratt, Francis S.
Prentice, Phillip B.
Procoter, William R.
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Racicot, P. A.
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Rapee, Frank J.
Rector, Thomas N.
Regan, Edward F.
Reiling, Howard A.
Riddell, John F.
Rixey, Eppa
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Romilly, Edgar P.
Royce, Harrison S.
Russell, G. P.
Rutledge, George F.
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Scery, J. W.
Schaufele, H. J.
Scheirz, E. R.
Schmidt, Mott B.
Schultz, Addie D.
Schwarz, M. W.
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Shaw, Joseph T.
Sibert, Eugene
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Hillery, Harry M.
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Hoguet, Rene
Holland, Martin A.
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Hooper, Noel J.
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Hudson, W. E.
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Katz, Sidney H.
Keller, Alexander W.
Kellogg, Edward A.
Kempton, Robert E.
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Kerr, George M.
Klauber, Murray
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King, Arthur G.
King, John L.
King, T. S.
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Lamb, Lloyd B.
Lambert, Marion L. J.
Latson, Frank W.
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Lewis, Walter H.
Leyden, James, Jr.
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Long, Howard A.
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Towler, Thomas W.
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Watson, Warren M.
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J. J. Kearns
V. P. Woodbury
Basil G. Woods
Luther L. Killam

CHEMICAL WARFARE SERVICE

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Raymond F. Bacon
Amos A. Fries
Edward N. Johnston
John W. N. Schulz

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James F. Norris

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William R. Hamor
Joel H. Hildebrand
Gilbert N. Lewis
William G. Lockwood
Charles E. Richardson
William O. Sibert

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Colin Mackall
Ben H. Nicolet
Earl Patterson
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Earl C. Smith
Adrian St. John
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Leon F. Urbain
Ralph D. Ward
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Abram M. Fisher
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Quicksilver in California

Editorial Correspondence

Foreign Competition

THE conference between the United States Tariff Commission and producers of quicksilver held recently in San Francisco brought out very strikingly the handicaps we are working under as compared to Spain. In the latter country, government-owned mines operated by contractors using convict labor are producing metal from orebodies worked for centuries, and still yielding large quantities of 7 per cent ore. Even considering their crude methods—it is said that a Peruvian furnace built in 1634 is still being used—their production is estimated to cost no more than $16 per flask of 75 lb., and thus dominates the world-market. At any rate their contract with the Rothchilds' London house to sell their product at not less than £7 per flask nets them a very handsome profit at the minimum price.

In the United States, on the other hand, the deposits are small, irregular, and normally of low grade. While there are some mines which have never entirely shut down since their discovery about 1850, and some containing relatively rich ore, the industry steadily declined for several years immediately preceding the war. At that time a sudden inflation and violent fluctuations resulted in the price finally being fixed at $105, an increase of 150 per cent over the normal. This induced the opening of many prospects, but 90 per cent of the increased output still comes from companies operating four years ago. However, the grade of ore is very low, the New Idria in San Benito County, California, which is America's greatest quicksilver mine, now treating ore containing but 6½ lb. mercury per ton. The Sulphur Bank Association in Lake County, California, is steam-shovelling old dumps and surface workings containing no more than 1¼ lb. metal per ton, which may be considered the present minimum limit for profitable extraction. Generally speaking, the average American ore mined today contains about 5 lb. of quicksilver per ton, that is to say, a metal content of 0.25 per cent, as compared to 0.85 per cent mined in Austria, 1 per cent in Italy and 7 per cent in Spain.

Concentration at New Idria

Such lean ore seems to offer a promising field for modern concentration methods. Indeed, many miners and metallurgists have attacked the problem recently despite the dictum of the older operators that "you can't concentrate quicksilver ores." The sulphide cinnabar has a specific gravity of about 8.0 as compared to that of 4.2 of the easily-treated calcopyrite. It has been demonstrated that if the cinnabar is massive and crystalline, and stage-crushing be carefully done to avoid sliming the very friable mineral, very good recoveries (up to 86 per cent) may be obtained on tables working with classified and deslimed sands. On the other hand, if the ore has been ground so as to slime the cinnabar, the values float in suspension like "paint," and are not recoverable on table, vanner, or flotation machine. Under such conditions the recovery may easily fall to 60 per cent or even lower.

Thus a well equipped and carefully controlled operation is essential to success, and it is not surprising that the many mills which were hurriedly installed a couple of years ago at the height of the fashion are generally abandoned. Two, which are probably the largest in California, are still in operation—one at the New Idria treating 300 tons daily, and another of 350-ton capacity treating Sulphur Bank ores. According to Mr. H. W. Gould, general superintendent of these properties, even these mills are economically unjustified, and their closure is imminent. A brief description of the flow sheet at New Idria, however, may be worth while (Fig. 1).

The ores are dumped over a grizzly into the mill bins, from whence they are drawn on a belt conveyor to a ⅛-in. trommel. The oversize enters a 7 x 6 ft. Allis-Chalmers granulator ball mill with a screen discharge, the ground material entering a 6-cell Richards hydraulic classifier. Each cell of this classifier supplies feed for

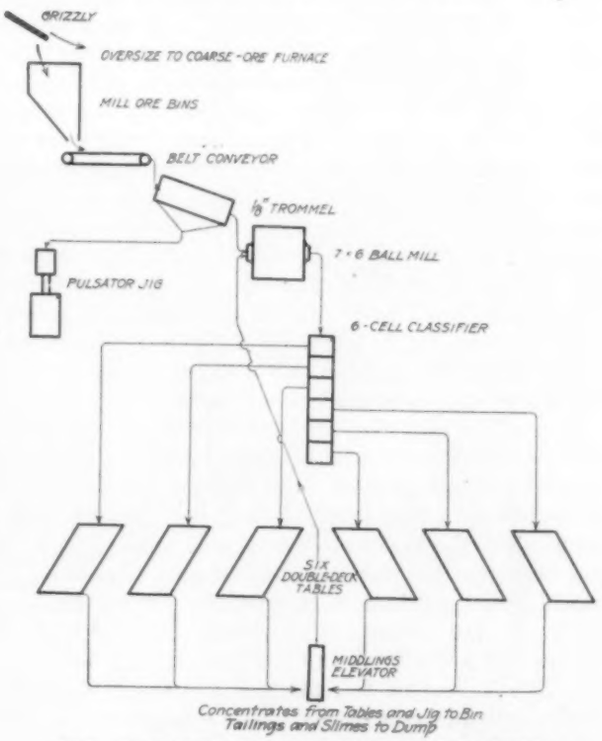


FIG. 1.—FLOW SHEET OF NEW IDRIA MILL

one of a battery of six double-deck Deister sand tables. The table tailings, together with the considerable quantity of valuable slimes, go to the dump; the concentrates, containing perhaps 70 per cent of the values, to bins; while all middlings are returned by elevator to the head of the system for regrinding and retreatment.

The conditions at Sulphur Bank are quite unique. Here, as already noted, a steam shovel loads motor trucks with ore from old mine dumps and upper workings averaging only 1¼ lb. of mercury per ton. These trucks dump their load on a 1½-in. grizzly—all oversize is wasted, as the bulk of the values is in the fines. The undersize is drawn from a storage bin by a mechanical feeder into a long trommel with various openings ranging from 1 in. to about 20 mesh. All portions ⅜ in. and coarser are separately stored for future rehandling, while the material from ⅜ in. to 10 mesh is roughly concentrated in a single compartment jig. Material finer than 10 mesh is classified, the sands being con-

centrated in Deister-Overstrom tables and the slimes on Frue vanners. The total recovery in this mill, owing to the peculiar conditions surrounding its operation, possibly does not exceed 30 per cent; all slimes and sand-tailings are carefully stored, however, for future treatment. In this manner the concentrator acts as a device to skim the cream from the feed—to get some concentrates ranging in richness from 3 to 50 per cent for quick recovery of the metal at a period of high price and insistent demand.

Economics of Concentration

This probably is the present function of concentration of quicksilver ores; to get a little rich material to mix with the coarser low-grade furnace-feed so as to increase the mercury output of present furnace and condenser equipment. The calcining of the ores is simple, efficient and cheap, costing not more than 75 cents per ton, and it is doubtful if the cost of modern concentration in small isolated plants can approach that of furnacing, even considering the much lower fixed investment in the mill per ton-day capacity. Added to this is the variation in nature of the different small ore deposits, each requiring close study to effect good recoveries—one will slime excessively during crushing, another may refuse to act satisfactorily in a flotation machine, another may be very costly to grind. These difficulties have converted many milling enthusiasts to the attitude of the "old timer." In other words, decreased costs may better be expected through increased efficiency in mining, which is three times as expensive as the subsequent metallurgical treatment.

A possible field for concentration is in connection with the development of a new prospect. Here the mineral indications might not warrant the building of an expensive furnace plant—indeed, the operators might readily lack the required capital—but a small crushing and table or flotation plant could easily be installed which would produce a concentrate worthy of shipment. As the orebody is developed, the returns from the ore will provide the funds for a local calciner, when the old mill can be discontinued and the raw ore together with the mill slimes and tailings smelted. Certain peculiar types of ore may be developed which are evidently concentrating propositions par excellence. As an example, the Black Butte Mercury Mining Company in Lane County, Oregon, has a peculiar soft ore which crushes very easily and floats very well, reducing the costs to a minimum.

Mercury Furnaces

Concentrates, or very rich, fine ores in small quantity, are best treated in retorts. In its most simple form, such a furnace consists of a horizontal row of up to a dozen 12-in. iron pipes, closed at the rear with a tight removable plug, and the front fitted into a condenser, which may be merely a water jacketed 3-in. pipe, 7 to 10 ft. long. The muffles themselves may be entirely bricked in, and heated by flues leading underneath and above, leading from a wood-burning fire box or oil-flame at one end. The retorts have a small capacity, handling perhaps 150 lb. of rich ore or 75 lb. of concentrates (plus the necessary lime) per shift. Condensation of fume is easiest, since only in this type is the volatile mercury uncontaminated by the products of combustion.

Coarse low grade ore, 3 to 9-in. lumps, on the other hand, has long been treated in vertical shafts resembling lime kilns of round or oblong cross-section. In order to prevent top-losses, a bell-charging device is desirable, the vapors being drawn off at about 200 deg. C. through down-comers just below, or through multiple openings in the shaft walls. The calcined ore is removed from the bottom at a temperature around 600 deg. C. and calcination is effected by fire-boxes located just above. These furnaces are very economical of labor and fuel, requiring one cord of wood for 20 tons of ore, while a rectangular oil-burning shaft at New Idria has been treating from 25,000 to 30,000 tons of ore per year at a total cost of somewhat less than 50 cents per ton. Since the "furnace gets it all" in the words of the operators, one readily sees what stiff competition any scheme of concentration would encounter in these calciners.

Scott Furnace

Perhaps 75 per cent of the American production in recent years has been obtained from finer ore treated in the Scott furnace, an improved Hasenclever furnace developed by Hüttner, Scott and Randol at New Almaden in 1875. As is perhaps well known, the Scott furnace is a rectangular block of brickwork with combustion chamber at one end and a fume chamber covering the end opposite. Between the two and leading from front to back are a series of parallel vertical slots, perhaps 20 in. wide, open from the top, where ore is charged, to the bottom where it is withdrawn. In its passage through the furnace, however, the ore rests on 30 or more deflecting shelves (Fig. 2) inclined downward at 45 degrees alternately from right and left wall,

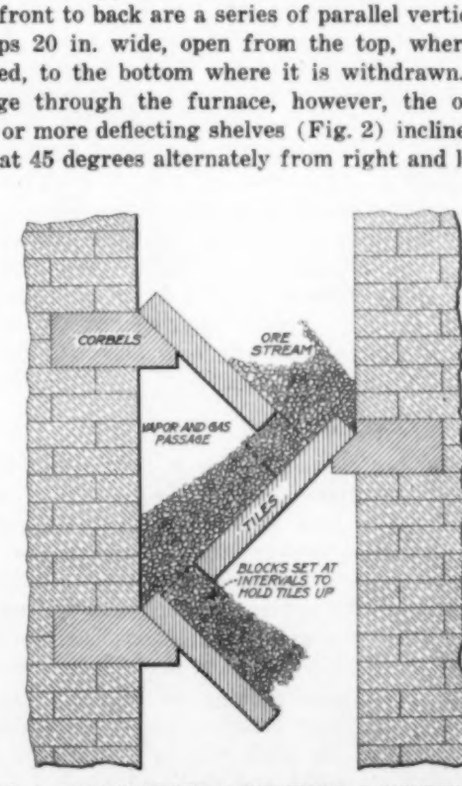


FIG. 2.—CROSS-SECTION SHOWING CONSTRUCTION IN SCOTT FURNACE

made of a line of 15 x 3 x 36-in tiles. The tiles are set so that a slot of about 5 in. is left between the lower edge and upper surface of each succeeding pair of tiles, which slot is kept sealed by the descending ore stream. Furnace gases use the space between the top of the ore

and the bottom of the tile immediately above as a flue, heating the thin bed of slowly descending ore and volatilizing its mercury content.

The capacity of the furnace is evidently a function of the length and the output of the mine it serves. It is commonly built of 75-ton capacity, with locally-made red brick for condensers and furnace masonry, and its cost is commonly quoted at $1000 per ton-day capacity. Dry granular ore fed to the top remains in the furnace about 24 hours before being drawn off below, during which time its temperature progressively increases to perhaps 1000 deg. C. Naturally, proper firing is an essential, 5 to 6 gallons of fuel oil or 0.03 to 0.05 cords of wood per ton of ore being required. This could be somewhat reduced, and an increased efficiency in the condensation system attained by more careful firing and narrow regulations of excess air of combustion. As it is, the cost of treatment is quite low—70 to 80 cents per ton, exclusive of interest and repairs, which latter are quite extensive at intervals of perhaps three years.

Furnace Recovery

Metallurgically, the Scott furnace is a very efficient machine. As determined by Dr. L. H. Duschak of the Bureau of Mines, the top losses are extremely low, owing to the effective seal made by the fine ore. In one case it amounted to about ½ lb. of mercury per day in a 50-ton furnace. The calcined ore contains only a negligible amount of values; under good operation it assays as low as 0.02 per cent, while ordinary care will produce a cinder with 0.07 per cent Hg. Losses of metal as uncondensed vapor escaping up the stack have generally been considered most serious, but Dr. Duschak shows that if 75 tons of 0.7 per cent ore is burned with the usual excess air of combustion, and the resulting gases cooled to 40 deg. C., the uncondensed vapor will amount to only 4½ lb. of mercury. The stack losses of fine fume are practically zero if the gases are cooled with a water spray; this water of condensation in turn dissolves some acid but very little metal, and its floating content of floured mercury can be reduced by proper settlement or recovered during re-use. Altogether, the furnace extraction under good management may very readily exceed 90 per cent. As a matter of fact, average practice bottles no more than 75 per cent of the mercury in the ore. (Mercury "hangs up" in the condenser system in excessive measure—at one well-conducted plant a monthly metallurgical balance showed recoveries ranging from 60 to 130 per cent.) Definite figures are difficult, if not impossible, to obtain, for few plants make any serious effort to sample and weigh the ore as it is fed, nor account for any metal in process except that actually shipped. A leaky system operating at slightly greater than atmospheric pressure may lose much vapor at the joints. This is entirely overcome, however, by maintaining a slight suction at all times by stack or fan draft.

The most important apparent loss is in the absorption of metal by the brickwork and foundation. This is very difficult to estimate and is not considered an ultimate loss as the mercury so absorbed is largely recovered when the plant is dismantled. It is an important factor in a new plant, since, by tying up a considerable amount of metal, it has the effect of increasing the capital investment required at the commencement of operations. In periods of abnormal prices, furnaces have been frequently dismantled to recover this mercury—a practice not consistent with good metallurgy, but often financially advisable. As much as 1000 flasks is reported to have been produced by the tearing down of a single furnace and condenser system, and old furnace sites have been excavated to a depth of 35 ft. before reaching earth not carrying visible beads of "quick."

Mechanical Roasters

Metallurgically the process of extracting mercury from the ore is quite similar to the roasting process practiced in large measure elsewhere, the reaction induced by extraneous heat,

$$HgS + O_2 = Hg + SO_2,$$

$$\text{or } 4HgS + 4CaO = 4Hg + CaS + CaSO_4,$$

taking place above the boiling point of mercury (360 deg. C.). It is only natural that roasters of the Herreshoff type so successful elsewhere should be tried, as has been done at New Almaden, where one treats 45 tons of ¾-in. ore daily.[1] The sulphur in the ore is insufficient to provide much of the required heat, so extra fire boxes are installed. A high consumption of fuel (8 gal. oil per ton) is required, owing to the radiation through the relatively thin walls, and an excessively dusty gas is made. This is treated while at 600 deg. F. in a Cottrell electrostatic precipitator, the gas then cooled and the mercury condensed in ordinary chambers, the cold effluent of which passes through a second cold Cottrell treater, which actually collects a vanishingly small amount of mercuric mist. At this plant a very large Scott furnace has recently been installed of 90 tons daily capacity, which produces a clean vapor with ⅔ the fuel consumption—this of course being a simpler and more desirable combination than the mechanical roaster.

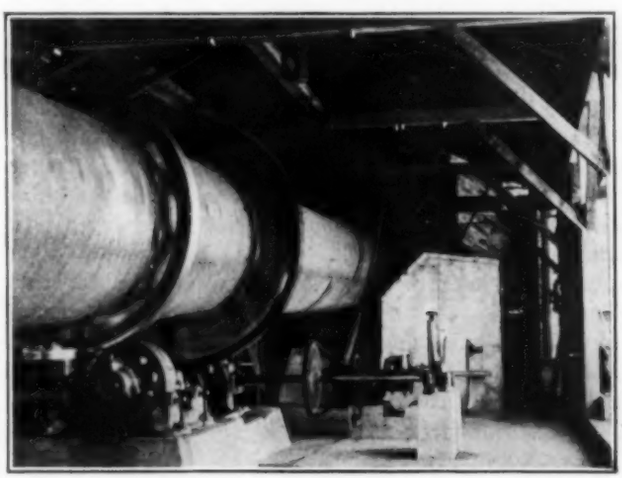


FIG. 3.—ROTARY QUICKSILVER FURNACE AT NEW IDRIA

H. W. Gould of the New Idria Company has recently tested a 4 x 50-ft. rotary furnace with very promising results, so much so that a second 5 x 56-ft. furnace was later installed, and four more are under order. The fur-

[1] See W. H. Landers, *E. & M. J.*, Oct. 7, 1916, p. 634.

nace, which is shown in Fig. 3, is like an ordinary cement kiln, receiving ore at the upper end, coned slightly to keep the discharge free of material. The furnace is fired not enough so that the entire lining is at a temperature of more than 350 deg. C., thus preventing any metal absorption. The first furnace treated 95 tons of 1½-in. ore daily, or 70 tons of 1½-in. ore; probably ¾ to

FIG. 4.—WOODEN CONDENSER TANKS AT NEW IDRIA

1-in. size will be most desirable, the ore remaining in the furnace from 15 to 30 min., depending upon the volume of the ore stream, and leaving at a temperature of over 900 deg. C. in a mercury-free condition. The further advantages of this rotary furnace are its low first cost, being one-quarter to one-half that of older types, and its low consumption of fuel, while the automatic feed and discharge cuts attendance charges to a minimum.

Condensation problems have been attacked at this plant with notable success, as well. The hot dusty gases first enter a brick dust chamber of considerable volume at the end of the furnace, where the solid particles largely settle. The gases, still at 300 deg. C. or more, then pass through a flue made of 18-in. sewer tile into the first wooden tank shown in Fig. 4, 20 ft. in diameter and 30 ft. high. Several sections of this tile flue have side outlets, through which a tile bend enters, open to the air at the outer end and the inner turned in the direction of the gas stream (Fig. 5). Fixed at the end of the tile bend is a water spray which not only cools the hot gases by its evaporation, but sucks outside air into the flue by injector action. The result is that the hot dry gas leaving the brick chamber enters the wooden condenser saturated with water vapor and at about 80 deg. C. During the passage through the three condensers shown in Fig. 4, the gases further cool to 40 or 50 deg. C., depositing practically all of their mercury and much of their water—the bulk collecting in the first tank. The condensers themselves are placed several feet above a concrete basin, and the mercury and water withdrawn periodically through valve-controlled drain pipes. Very little soot is formed in this installation, thus warranting the discontinuance of their rather elaborate soot-mill.

The advantages of this condenser system are obvious. Wooden tanks are very easily and cheaply built and kept air tight, metal absorption is very low, clean-ups may be readily effected by merely hosing down the walls, the metal is withdrawn without the dangerous necessity of entering the condensers, and there are no dead spaces for sulphuric acid and mercury gases to eddy about and combine. Mr. Gould and his associates are to be congratulated on this very evident advance in the art of getting quicksilver.

The expected consumption of quicksilver in the United States during the year 1918 was estimated in April by Mr. F. L. Ransome, of the U. S. Geological Survey, as follows:

	Flasks
Drugs and chemicals, largely calomel and dental amalgams	12,180
Fulminate for detonators	12,218
Antifouling ship-paint (red oxide)	2,905
Vermillion (mercuric sulphide)	1,900
Electrical uses in rectifiers and vapor lamps	2,687
Felt making (mercuric nitrate)	1,800
Amalgamation of gold and silver ores	800
Thermometric, barometric and other scientific instruments	676
Boiler feed-water treating compounds	700
Cosmetics	300
Total	36,166

The mines of the United States could probably easily supply this amount if our exports were discontinued, since the production in 1917 amounted to 36,351 flasks. Great activity in production is necessary, however, since some of the manufacturers of fulminates have but recently received largely increased estimates of requirements for the army and navy, one estimate demanding more mercury than the entire total above given.

In case of an acute shortage, many of the uses could be considerably curtailed, either by non-supply or by substitution. For instance, cosmetics, water treating compounds, felt making, and vermillion could largely be foregone, temporarily. Miscellaneous chemicals could be sharply curtailed, as well. Substitutes for fulminate, were largely imported from Germany prior to the war and were used in blasting caps, replacing a large amount of fulminate when mercury was at prices above $40. These imported compounds are now about

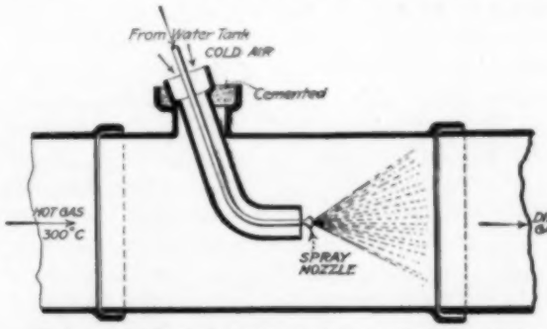


FIG. 5.—TILE FLUE FOR COOLING MERCURY VAPOR

exhausted, and their methods of manufacture are unknown—American-made substitutes require fulminate to detonate them, and may cut down the mercury consumption about 75 per cent. It is understood, however, that at present prices of substitutes it is cheaper to use pure fulminate when mercury is at $75 and probably even at the present $105. As to their reliability of operation, it suffices to say that the ordnance departments of the allied governments will not accept substitutes in caps or detonators. This confines their use to blasting caps for mining and excavation and in the making of sporting goods. In the latter case a misfire is not so vital, while in blasting the insertion of two caps in every important shot will insure 100 per cent operation at a small relative increase in cost.

The Metallography and Heat Treatment of Metals Used in Aëroplane Construction—III

Investigation of Parts Made from Chrome-Vanadium, Nickel, Chromium and Tungsten Steels—Causes of Failure in Piston Pins, Axles and Bolts—Physical Properties of Raw and Treated Materials

By F. GROTTS
Chief Metallurgist, Curtiss Aëroplane and Motor Corporation

Chrome-Vanadium Steel

Piston pins and connecting rods are made from chrome-vanadium steel. The piston pins have a slightly higher carbon content than the connecting rods. This material, when properly heat-treated, has a very fine structure and is very tough and strong.

The defects found are manganese sulphide, slag and seams.

Connecting rod analysis: C, 0.35; Mn, 0.78; S, 0.027; P, 0.025; Cr, 0.94; V, 0.17.

Physical properties of raw stock.

Ultimate tensile strength, lb.	136,700
Yield point, lb.	85,200
Elongation, per cent.	15.6
Reduction, per cent.	45.5
Brinell	302
Scleroscope	42

Double quenched 1700 deg. and 1600 deg. in oil; drawn at 1200 deg.

Ultimate tensile strength, lb.	145,000
Yield point, lb.	135,000
Elongation, per cent.	18
Reduction, per cent.	62
Brinell	300
Scleroscope	48

Piston pins are drawn at 1000 deg. and it is essential that the greatest possible care and supervision be given them in order to get satisfactory results. Defects have been found in pins that were thought to be seams but were in reality due to faulty heat-treating. In quenching, the pins should be dropped in vertically and not tossed in indiscriminately. Oil is nearly always used as a quenching medium but hot water can be used with good results. This is similar to the conditions found under chrome-nickel piston pins where the hardening cracks occurred.

Piston Pin Investigation

These pins are made from chrome-vanadium steel and have an analysis of C, 0.46; Mn, 0.68; S, 0.028; P. 0.032; Cr, 1.12; V, 0.14. On being machined small hair lines appeared that resembled a hardening crack; also it was observed that some pins were very soft.

The object of the investigation was to determine the cause of the cracks which in some cases extended from end to end, and also to investigate the heat treatment.

Procedure: The 50 pins submitted, which were supposed to have been heat-treated, were scleroscoped and showed a hardness of 20 to 26.

Fifteen of the pins taken as representatives of the lot were heated up to 1700 deg., held 10 minutes and quenched in oil. After they had cooled, they were requenched in oil at a temperature of 1600 deg., the hardness averaging 58 after the second quench.

Five of the 15 pins were drawn at 800 deg., air-cooled and showed a hardness of 53 to 55. Another 5 were drawn at 900 deg., air-cooled and showed a hardness of 49 to 52. The remaining 5 were drawn at 1000 deg., air-cooled and showed a hardness of 44 to 47.

A section taken at the crack was polished and photographed at a magnification of 100. The result is shown in Fig. 62. Another section was polished and etched with alcoholic nitric solution, with the result shown in Fig. 63.

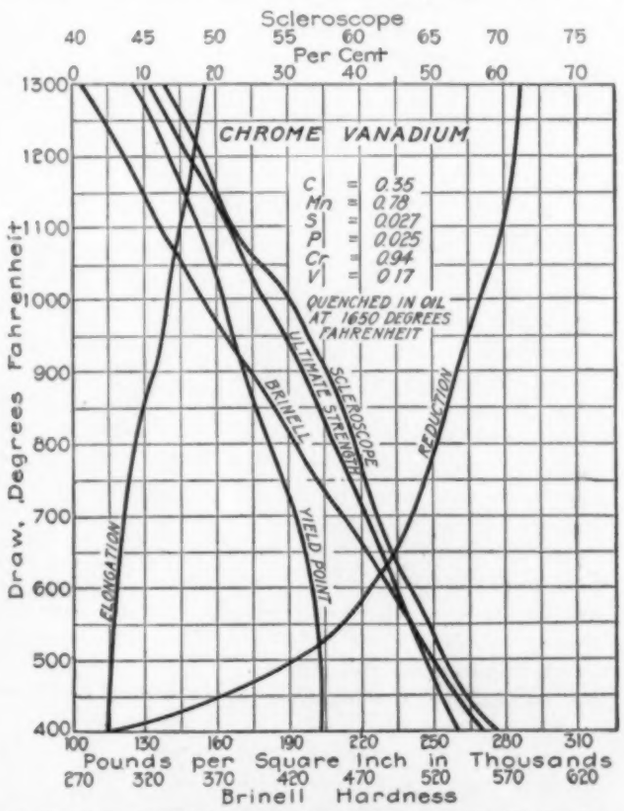
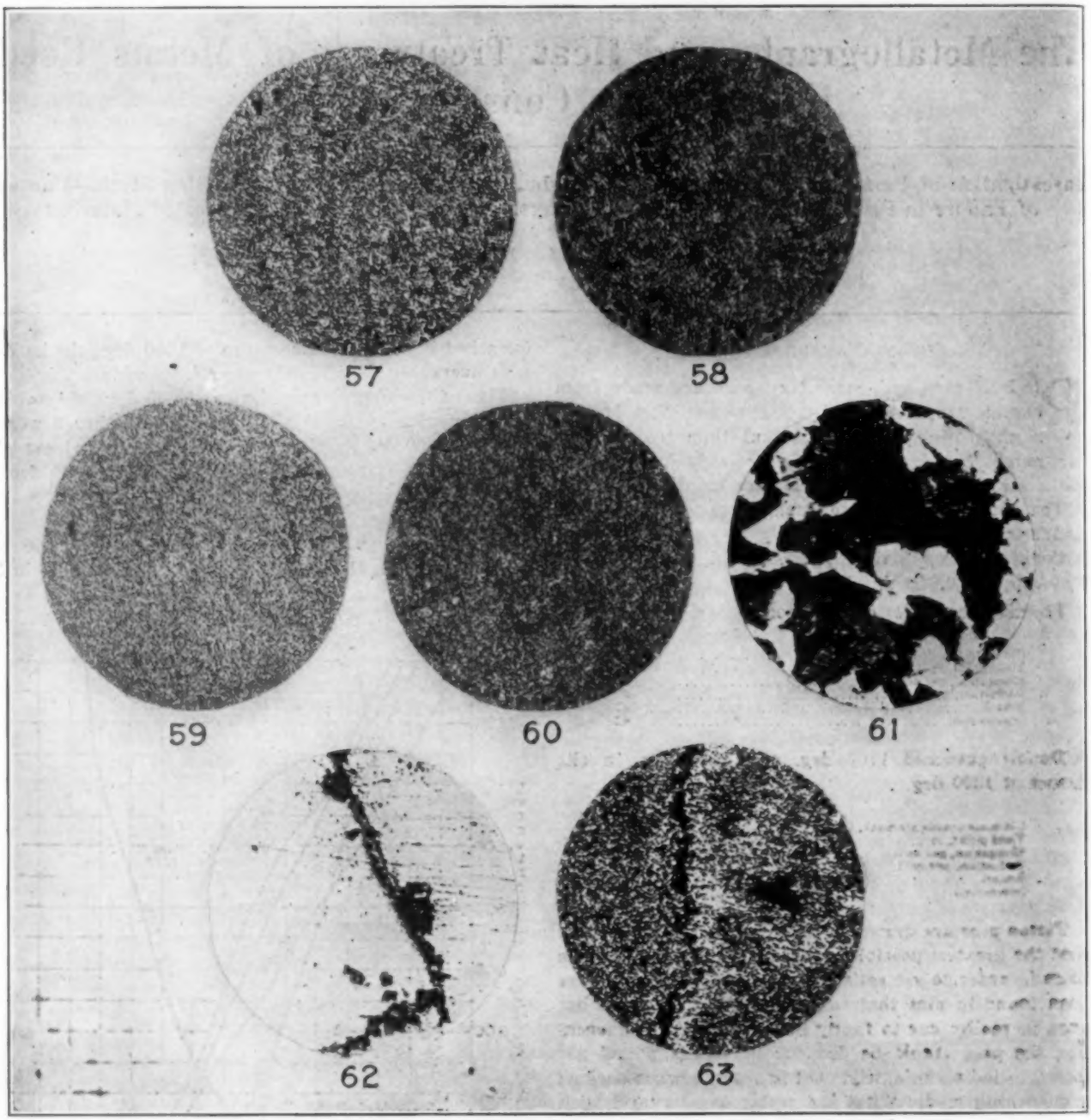


PLATE 5.—PROPERTIES OF CHROME VANADIUM STEEL

Summary: These pins when heat-treated properly give a hardness of about 50 to 55; so the treatment of these pins originally was incorrect (drawn too high). The cracks found were seams containing oxide, as shown in Fig. 62.

Fig. 63 shows how the steel was decarbonized near the seam. The structure shows ferrite with sorbite, indicating that the draw was somewhat too high, probably about 1250 deg. Fahrenheit.



FIGS. 57-63

Figs. 57-61—Chrome Vanadium Steel. Analysis: C, 0.35 per cent; Mn, 0.78; S, 0.027; P, 0.025; Cr, 0.94; V, 0.17. Etched with picric acid; magnification, x 100. Fig. 57—Quenched; 58— quenched and drawn at 800 deg.; 59—quenched and drawn at 1000 deg.; 60—quenched and drawn at 1200 deg.; 61—raw stock; x 400. Figs. 62-63—Cracks in piston pins; x 100.

NICKEL STEEL

This is a typical pearlitic steel and one of the most important in aëroplane construction, as the nickel going into solution into the ferrite increases its strength, elastic limit and hardness, which in turn makes a stronger and harder pearlite, therefore a better steel than an equivalent carbon steel. It will stand lots of cold working in the annealed state. It is used for bolts, nuts and parts subject to shock.

The average composition is C, 0.32; Mn, 0.50; S, 0.035; P, 0.0173; Ni, 3.74.

The critical points are slightly lower than those of a same percentage carbon steel, the heating point being about 1325 deg. F. and the cooling about 1175 deg. F.

It is very susceptible to oxidation and should be placed in boxes or handled in a reducing or neutral atmosphere when being heat treated.

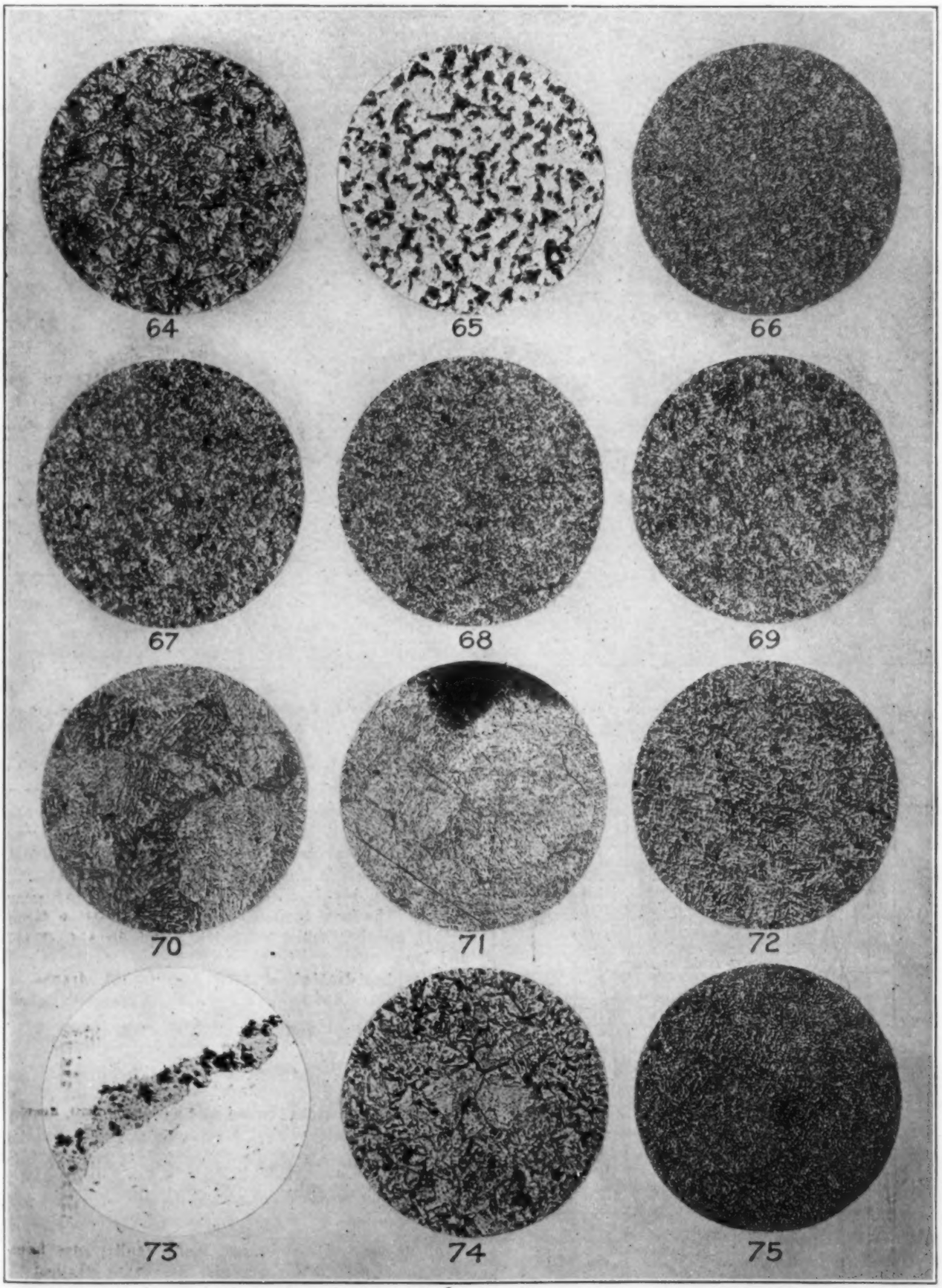
Raw stock physical properties:

Ultimate tensile strength, lb	112,200
Yield point, lb	97,200
Reduction, per cent	49.9
Brinell	217
Scleroscope	40

Quenched in oil at 1500 deg. F. and drawn at 1000 deg. F.:

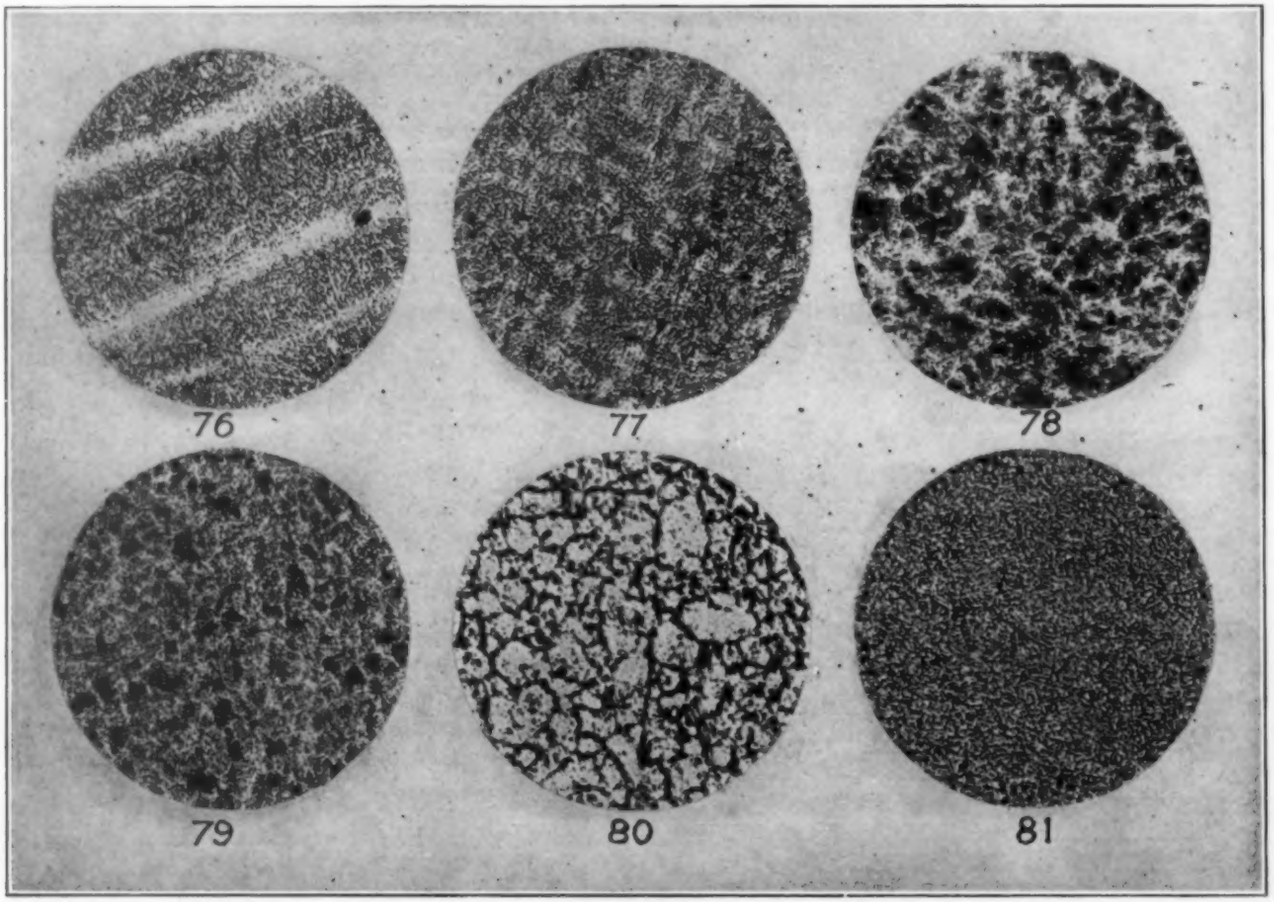
Ultimate tensile strength, lb	120,000
Yield point, lb	100,000
Reduction, per cent	65
Elongation, per cent	20
Brinell	230
Scleroscope	38

The most common defects found in this stock are pipes and slag inclusions. More pipes are found in this material than in any other. Owing to the peculiar frac-



FIGS. 64-75.

Figs. 64-69—Nickel Steel. Analysis: C, 0.32; Mn, 0.50; S, 0.035; P, 0.017; Ni, 3.74. Etched with picric acid; magnification, x 100. Fig. 64—Raw stock; 65—furnace annealed; 66—quenched; 67—quenched and drawn at 800 deg.; 68—quenched and drawn at 1000 deg.; 69—quenched and drawn at 1200 deg. Fig. 70—Nickel steel axle. Fig. 71—Surface lines on axle. Fig. 72—Axle after treatment. Fig. 73—Sand split in bolt. Fig. 74—Over-heated bolt. Fig. 75—Same, properly heat-treated



FIGS. 76-81

Chrominum Steel. Analysis: C, 0.24; Mn, 0.36; S, 0.013; P, 0.02; Cr, 10.44; V, 0.30. Etched with picric acid; magnification, x 100. Fig. 76—Raw stock; 77—furnace annealed; 78—quenched; 79—quenched and drawn at 1000 deg.; 80—quenched and drawn at 1100 deg.; 81—quenched and drawn at 1200 deg.

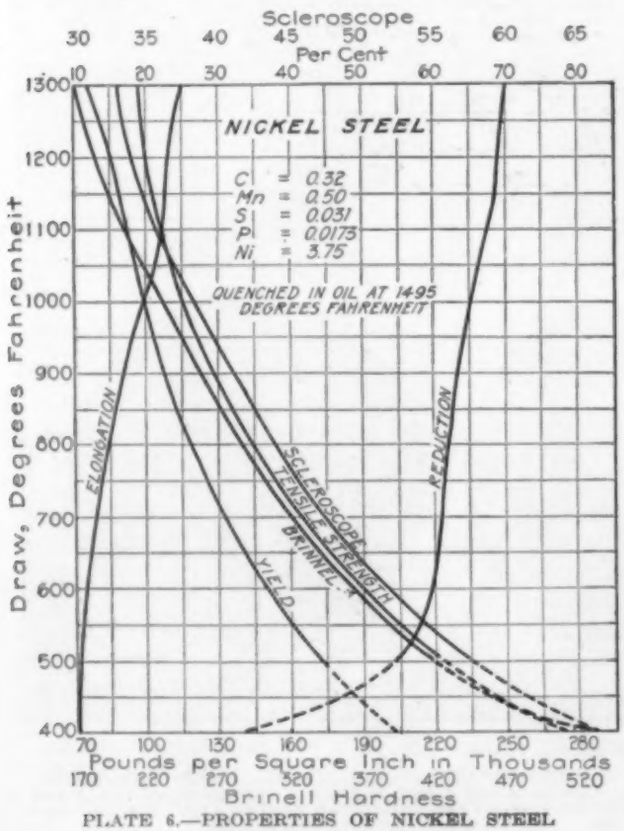


PLATE 6.—PROPERTIES OF NICKEL STEEL

ture sometimes resembling a pipe, it is necessary to take sections, polish them, and examine them under a microscope in order to show conclusively the presence of a pipe. Stock that at times appeared to be faulty or injured by heat treatment (oxidation) was in fact torn and pitted by faulty machining (automatics).

Nickel tubing is used for axles and landing gear braces. The most common defects are inclusions (iron oxide) rolled in from insufficient ingot discard, seams and laps.

Axles heat-treated at 1500 deg. in oil, drawn at 500 deg.:

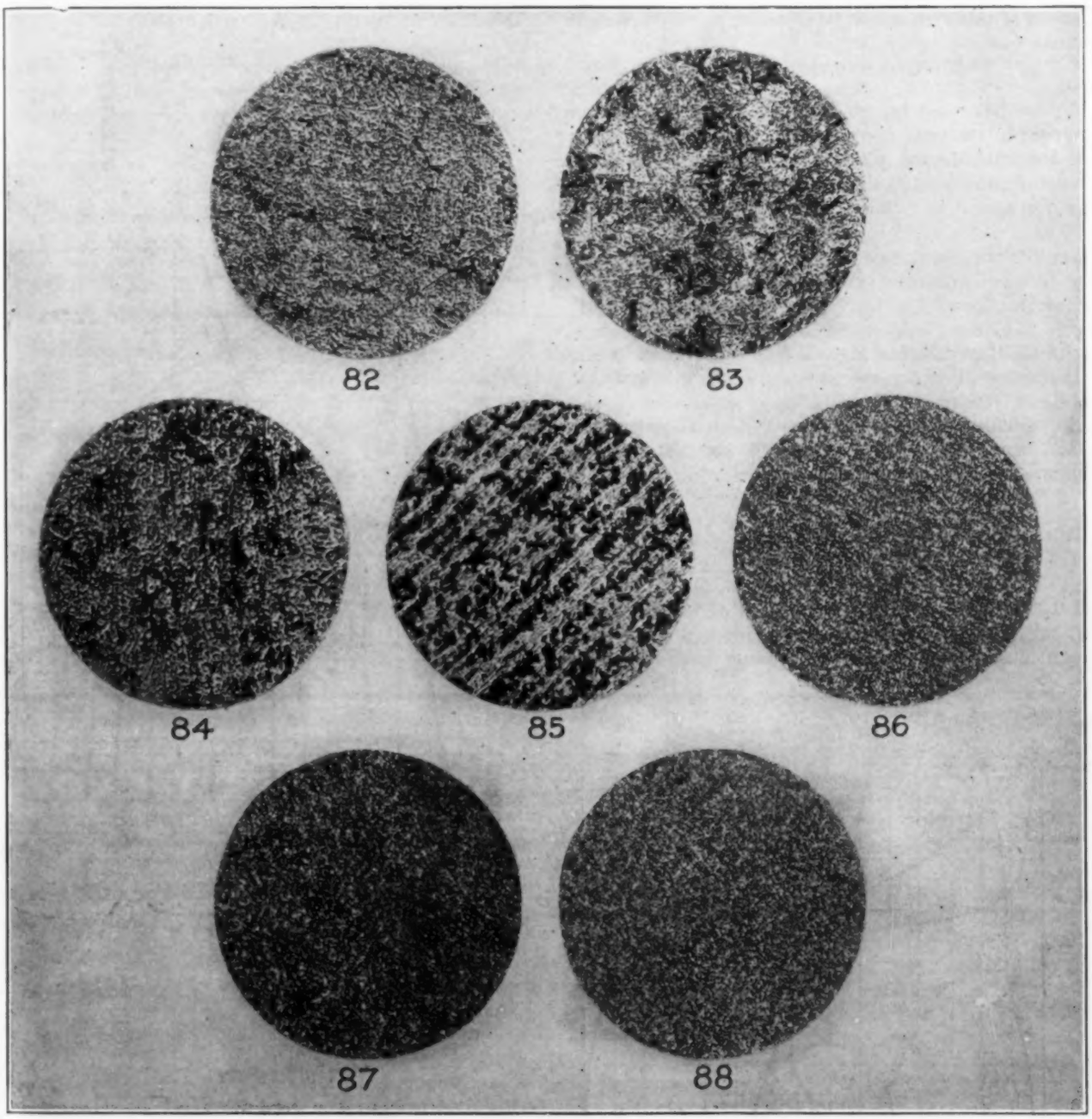
Ultimate tensile strength, lb	218,000
Yield point, lb	175,000
Elongation, per cent	11
Reduction, per cent	50
Brinell	420
Scleroscope	57

Landing gear brace treated at 1500 deg. in oil, drawn at 850 deg.:

Ultimate tensile strength, lb	140,000
Yield point, lb	115,000
Elongation, per cent	16
Reduction, per cent	64
Brinell	272
Scleroscope	43

In the case of the braces, many faulty ones have been found due to the fact that they were strained in bending. They should be heated up to 1400 to 1500 deg. before being bent, then given the above heat treatment.

An axle made from nickel-steel tubing showed very brittle properties and lines along its entire length. The



FIGS. 82-88.

Figs. 82-85—Vanadium Steel. Analysis: C, 0.22; Mn, 0.72; S, 0.039; P, 0.04; V, 0.12. Etched with picric acid; magnification, x 100. Fig. 82—Quenched stock; 83—quenched and drawn at 800 deg.; 84—quenched and drawn at 1000 deg.; 85—annealed. Figs. 86-88—Tungsten Steel. Analysis: C, 0.47; Mn, 0.28; S, 0.025; P, 0.01; Cr, 3.15; V, 0.72; W, 15.55. Etched with picric acid; magnification, x 100. Fig. 86—Quenched in oil; 87—heated to 1950 deg. and cooled in air; 88—quenched and drawn at 1400 deg.

object of the investigation was to determine the cause of the brittleness and also to investigate the lines.

A section was taken and examined carefully, then polished, etched and photographed. This section was scleroscoped and brinelled, then drawn at a temperature of 500 deg.

Fig. 70 shows the structure and nature of the axle. Fig. 71 shows the peculiar surface lines that occurred along the length of the axle. The material as it was, scleroscoped 65 and brinelled 495; on being drawn at 500 deg. for 30 minutes, it scleroscoped 55-56 and brinelled 395-400 (See Fig. 72).

Summary: The investigation shows that this material was merely quenched and never drawn at all. The surface lines were folds. In the forging or rolling of the steel, thin plates or sheets of oxide were folded in. Material that has as many folds as this should be rejected as it will certainly fail when subjected to stress or vibration. A flaw of this kind can never be improved and there is no question but that it will grow.

Bolt Investigation

Two parts fabricated from nickel-steel were investigated becase one failed in service. A section of the one that had not had the strain of the other was polished, and photographed at a magnification of 100. It is shown in Fig 73.

This is a typical sand split and is made up principally from manganese sulphide. The sulphur prints show an abundance of sulphur. Bars that have in-

clusions of this size should be rejected, as they are unfit for use.

Overheated Bolt

A base bolt used for holding the engine in place, on shearing in two was investigated. A section on being polished, etched with picric acid and photographed at a magnification of 100 showed as in Fig. 74. This bolt was overheated at a temperature probably of 1850 to 1900 deg. As it is, it is very soft and has no strength. Cases like this occur when couples do not register properly or when workmen sleep on the job.

Material shown in Fig. 74 was heat-treated by heating to 1525 deg., holding for ten minutes and quenching in oil, then drawing at 1000 deg. and cooling in air. It is interesting to observe in Fig. 75 that this material has been refined very nicely. Carbon steels of the same carbon content as this nickel steel when handled at the same temperatures failed to give satisfactory results.

Chromium Steel

This steel is particularly of value because of its noncorrosive properties. This particular steel having an analysis of 0.24 C, 0.36 Mn, 0.013 S, 0.020 P, 10.44 Cr and 0.30 V, was subjected to solutions of water, 10 per cent salt, 10 per cent sodium hydroxide and 1 per cent sulphuric acid for five days. There was no effect except

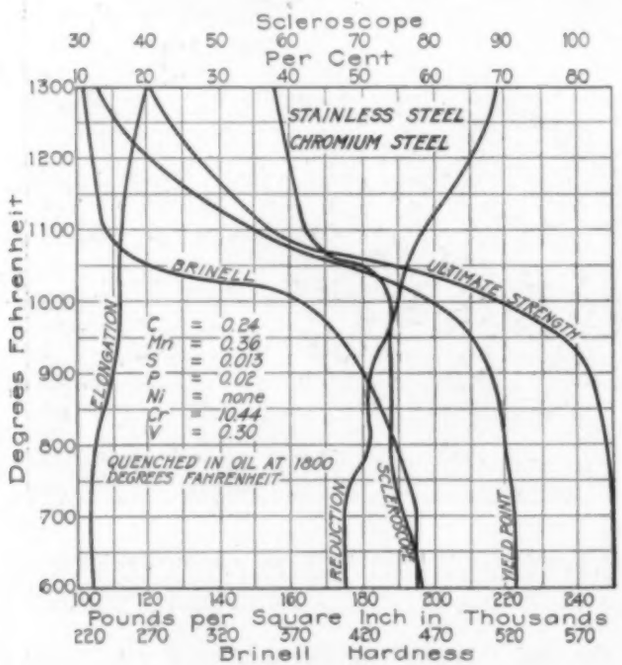


PLATE 7.—PROPERTIES OF CHROMIUM STEEL

in the case of the acid which darkened the surface of the specimen slightly.

Specimens on being quenched in oil showed that a temperature of 1800-1825 deg. gave the best results:

Temperature	Brinell	Scleroscope
1,400	179	34
1,450	187	35
1,500	351	53
1,550	364	55
1,600	387	57
1,650	418	61
1,700	477	60
1,750	512	62
1,800	532	65
1,850	512	65
1,900	477	62

Quenched at 1800-1825 deg. and drawn:

Temperature	Brinell	Scleroscope
600	460	58
700	460	56
800	444	54
900	425	54
1,000	380	54
1,100	248	42
1,200	241	40
1,300	235	38

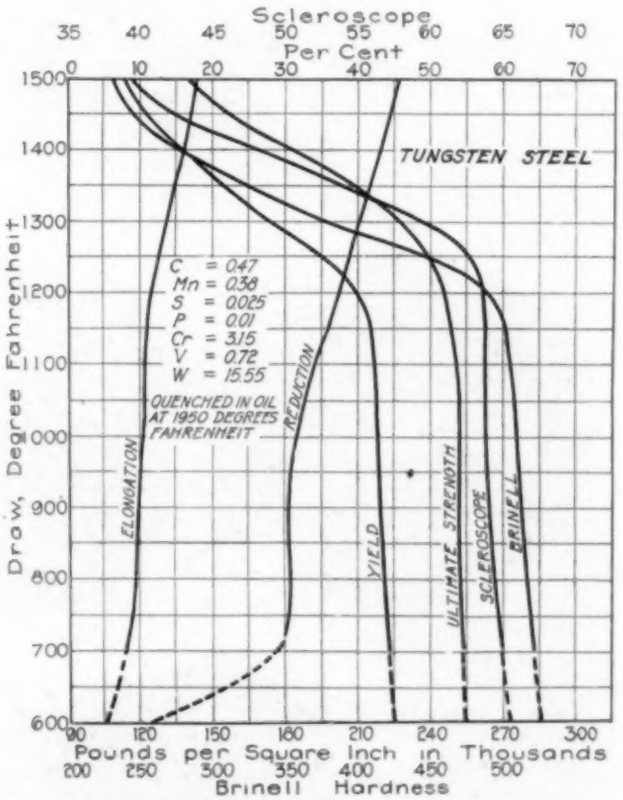


PLATE 8.—PROPERTIES OF TUNGSTEN STEEL

Physical properties when quenched at 1800-1825 deg. in oil and drawn at 850 deg.:

Ultimate tensile strength, lb.	225,000
Yield point, lb.	220,000
Elongation, per cent	14
Reduction, per cent	50
Brinell	430
Scleroscope	72

Vanadium Steel

This steel is especially good for sheet steel that has to be fabricated into parts that are punched, *e.g.*, machine-gun mounts, etc. It is very tough and has much better physical properties than ordinary sheet steel.

Chemical analysis: 0.22 C, 0.72 Mn, 0.039 S, 0.040 P, 0.12 V.

Quenched in oil, it gave the following results:

	1500 Deg.	1600 Deg.	1700 Deg
Ultimate tensile strength, lb.	139,000	195,300	202,000
Yield point, lb.	113,000	168,000	172,100
Elongation, per cent	3.00	4.5	6.75
Scleroscope	44	55	58

Quenched in oil at 1700 deg. and drawn:

	1000 Deg.	1100 Deg.	1200 Deg.	1300 Deg.	1400 Deg.
Ultimate tensile strength, lb.	124,000	118,600	106,000	88,000	75,600
Yield point, lb.	114,700	105,400	98,000	76,400	60,800
Elongation, per cent	14	15	15	18	20
Scleroscope	38	37	35	32	28

Tungsten Steel

Tungsten steel is used for high-speed cutting tools and exhaust valves. It requires a very high temperature to harden it successfully. An interesting property

is that it may be heated to a dull red and still retain its cutting properties.

Physical properties of raw stock:

Ultimate tensile strength, lb	110,000
Yield point, lb	84,800
Reduction, per cent	54.00
Elongation, per cent	24.00
Brinell	207
Scleroscope	35

Chemical analysis: 0.47 C, 0.38 Mn, 0.025 S, 0.01 P, 3.15 Cr, 0.72 V, 15.55 W.

Quenched at 1950 deg. in oil and drawn at 400 deg.:

Ultimate tensile strength, lb	248,000
Yield point, lb	225,000
Reduction, per cent	43
Elongation, per cent	6
Brinell	520
Scleroscope	64

(To be continued)

The Magnetic Permeability of Steel

Permeametric Measurement of Magnet Steels Used for Electrical Machinery—Value of Hysteresis Data in Standardizing and Inspecting Steel Tools—Commercial Permeameters

By FRANK P. FAHY

PERMEAMETERS are employed in the determination of the magnetic properties of materials. These properties may be considered to be defined by the normal induction and hysteresis data.

A normal induction curve, or the ascending magnetization curve, *OAC* in Fig. 1, is the curve determined by the plotting of points representing the values of normal induction (magnetization) reached under various magnetizing forces when the material under examination has previously been demagnetized. Magnetic induction, or flux density, is represented by the symbol *B*, and magnetizing force by the symbol *H*. The quotient *B/H* for any point on the normal induction curve gives the permeability or magnetic conductivity for the material under the conditions represented by that point.

If after magnetizing a specimen of material to a given value of induction the magnetizing force is decreased, the induction observed for the new value of magnetizing force does not correspond to the value previously obtained in the measurement of normal induction, but has a higher value. In other words, the descending curve of magnetization, *CDEFG*, shows a distinct lagging in the fall of induction with respect to magnetizing force. To finally reduce the induction to zero requires the application of a magnetizing force in the opposite direction to that originally imposed. To this lagging effect has been given the name hysteresis. The amount of lag varies with the nature of the material and the degree to which it has been previously magnetized.

The information to be derived from the normal induction and hysteresis data is of the first importance in the selection of material intended for use in the construction of electrical machinery or apparatus which depends for its efficient operation upon the magnetic characteristics of some component part. Sometimes material of high permeability and low hysteresis is required, as in generators, motors and transformers. On the other hand permanent magnet material must have opposite characteristics to the above.

The question of the magnetic characteristics of iron and steel, and necessarily the methods of measuring such characteristics, is one of importance to metallurgical chemists. The signal improvement in recent years in the magnetic quality of transformer steels is the happy result of skilled chemical and metallurgical treatment. The more recent work of Yensen[1] on electrolytic iron melted in vacuo, which when translated into practice will mean greatly increased operating efficiency in many forms of electrical apparatus, is another case in point. The magnetic characteristics of this exceptional

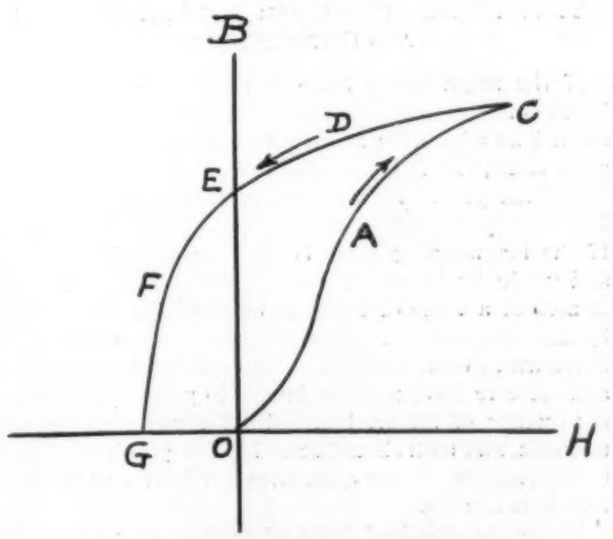


FIG. 1.—NORMAL INDUCTION CURVE

material may be modified by variations in chemical content so as to suit the material to special operating conditions.

At the present time particular attention is being given to research work on permanent magnet material. There are several reasons for this. First and foremost is the enormously increased demand for magnet steels for magneto construction. Again, a short time ago the scarcity and price of tungsten led to further investigation in the matter of substituting chrome as the preponderating alloying element. Chrome magnet steels were not unknown, but the action of tungsten being apparently more favorable to the attainment of the desired magnetic characteristics, the use of such steels was limited. While magnet steels of good characteristics are readily procurable today, it is a fact that develop-

[1] "Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo," Trygve D. Yensen, Engineering Experiment Station, University of Illinois, Bulletins Nos. 72 and 77.

ment work along this line has lagged to such a degree that there is room for very considerable improvement. Some of the more recently developed steels have yet to be subjected to tests in apparatus known to be capable of giving accurate test results before the claim made for them may be accepted.

The present interest displayed in the subject makes it desirable to explain briefly here the meaning of some of the criteria which are used to characterize permanent magnet steels. Material intended for this purpose is practically always used in the heat-treated condition; i.e., the raw stock is hardened in oil or water from above the critical range and may or may not be drawn thereafter. Sometimes the steel, after hardening, is subjected to an ageing process, thermal in nature, which consists in heating it several times to about 100 deg. C., each heating being followed by immersion in cold water. Another ageing process subjects the material to the effects of mechanical jarring. Both of these ageing processes are intended to mature the material by effecting promptly a large part of the change which would occur in the course of time due to the secular softening of the material. This maturing or ageing is of special importance where constancy of the original properties of the magnet must be maintained.

The Hysteresis Constants: Remnant Induction and Coercive Force

If the magnetizing force is removed, after the material is magnetized to a high degree as *C*, Fig. 1, under conditions where the magnetic circuit is entirely closed upon itself, the induction falls to the value corresponding to the point *E*. The value of this induction, shown by the ordinate *OE* is known as the residual induction. If the magnetizing force is then reversed in direction and gradually increased the induction is reduced finally to zero at a value of reversed magnetizing force shown by the abscissa *OG*. This reversed magnetizing force is known as coercive force. Both the residual induction and coercive force must be known to properly determine the quality of material intended for use in permanent magnets, and both should be as high as possible in value. Collectively these two quantities are known as the hysteresis constants.

While the standard tests of permanent magnet material are made under conditions where the magnetic circuit is closed upon itself, the influence of joints in this circuit being corrected for, magnets themselves are usually employed under circumstances where the magnetic circuit is open. An instance may be found in the case of a magneto, where the armature revolves between the open ends or poles of the magnet, which in this case is horse-shoe in shape. Here the circuit is made up of the magnet, two air gaps and the armature core. The open circuit modifies in an important manner the induction above designated as the residual induction, for the reason that the poles of the magnet exert a demagnetizing influence on the magnet itself which reduces the induction. We have then to consider a new term, namely, remanent induction. Remanent induction is to the open magnetic circuit what residual induction is to the closed magnetic circuit.

It is the remanent induction which serves the immediate useful purpose in a magnet, as it determines the strength of the magnet under the conditions in which it is to be used. The loss of induction due to the open circuit, that is, the difference between the residual induction and remanent induction, depends upon the form of the magnet, the value of the residual induction and the value of the coercive force. In Fig. 2 are plotted curves for magnet steel material Nos. 1 and 2 which

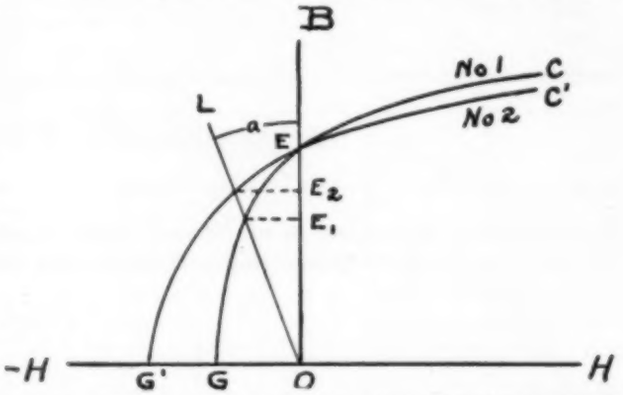


FIG. 2.—RESIDUAL INDUCTION AND COERCIVE FORCE

will assist in making this clear. The curve *CEG* for material No. 1 shows a residual induction equal to *OE* and a coercive force equal to *OG;* the curve *C'EG'* for material No. 2 shows a residual induction equal to *OE* and a coercive force equal to *OG'*.

The self-demagnetizing influence may be expressed by means of a coefficient or factor which in some cases can be calculated and is always subject to close experimental determination. If we assume magnets of the same size and shape made up of materials Nos. 1 and 2, then since the materials have the same form and the same residual induction the demagnetizing coefficients will be similar. The action of this coefficient may be shown graphically by drawing the line *OL*, making an angle *a* so that tangent *a* represents the demagnetizing coefficient. The intersection of the line *OL* with the curves *CEG* and *C'EG'* determines the remanent inductions of the two magnets. From Fig. 2 it will be seen that the remanent induction of the magnet made from material No. 1 is equal to OE_1, while that made from material No. 2 is greater and is equal to OE_2. It is obvious that the value of the coercive force is the determining factor in limiting the loss of induction.

Coercive force, besides being of value in helping to overcome the demagnetizing influence, is also of assistance in counteracting the effects of severe vibration which magnets are frequently subjected to under the conditions of use. The practical importance of high coercive force therefore lies not only in its action in cutting down the loss of induction due to the demagnetizing influence but also in its action in stabilizing the remanent induction. While high remanent induction must be the chief desideratum, it will be clear that it is arrived at and maintained only by means of a high coercive force. Since the demagnetizing factors for all conditions may be determined once for all, the testing and comparing of magnet steel material may be made on the basis of measuring the residual induction and calculating the remanent induction for the particular conditions of use. The coercive force values remain unchanged whether the magnetic tests are carried out either under closed or under open magnetic circuit conditions.

The practical usefulness of magnetic data has been greatly augmented by the proof that they furnish valuable information as to the mechanical and structural characteristics of those materials which are magnetic in character, as iron and steel, but are designed for use under conditions where their mechanical stability is all-important. The limitations of the microscope and the fact that hardness and chemical tests frequently fail to distinguish adequately between materials, where the magnetic test shows distinct differences, greatly augments the serviceability of this new addition to metallurgical test procedure. Comparatively great magnetic changes accompany thermal or mechanical treatment.

Waggoner[2] has shown that magnetic hysteresis and the maximum strength of steels vary in the same way with changing carbon content. Gumlich[3] has found that the coercive force of annealed steel increases linearly with the carbon content up to the eutectic and thereafter, but at a decreased rate after the eutectic is passed. Mars[4] has shown that there is a definite relation between the Brinell hardness and the residual induction in a series of iron carbon alloys. Burrows[5] has shown the wide changes in magnetic properties which accompany changes in heat-treatment procedure.

An important application of magnetic analysis in the laboratory is in the study of those materials or tools which have given exceptional performance, in order to determine wherein they differ from the routine output. The point that the test is not a destructive one warrants individual examination of more or less expensive tools at any stage in their manufacture. Routine examination requires of course that the magnetic criteria of a standard and satisfactory tool be established initially, and the allowable limits from the manufacturing standpoint determined.

The magnetic criteria use in correlating the magnetic and mechanical properties of materials vary according to the special problems involved. Frequently a single

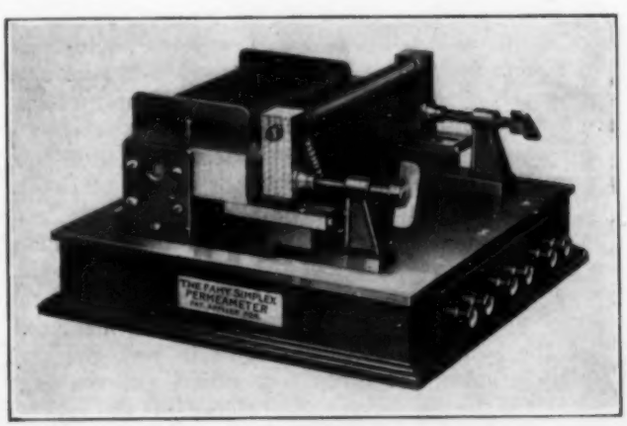


FIG. 3.—SIMPLEX PERMEAMETER

value of permeability determined under a definite magnetizing force suffices to define the state of a product, but in general one or both of the hysteresis constants are found most valuable, as these values are profoundly influenced by the existent structural and hardness conditions. Experience has shown that identical specimens of raw material when subjected to the same thermal or mechanical treatment will always have the same final magnetic characteristics. Departure from standard values established once for all for a given process of handling or manufacture, after allowance is made for practical manufacturing limitations, may be made to serve as a basis for rejection or culling.

Table I gives the results of hysteresis tests upon a lot of high-speed steel twist drills furnished under a definite chemical and thermal treatment specification. The values of the material in the annealed condition is as follows:

Residual Induction	Coercive Force
17,300	18.2

TABLE I—MAGNETIC TESTS OF HIGH SPEED TWIST DRILLS

Specimen No.	Residual Induction	Coercive Force
1	7100	41.6
2	7000	48.9
3	6980	44.2
4	6800	47.4
5	7030	47.4
6	7130	47.2
7	7040	48.0
8	7100	50.8
9	7150	42.0
10	7000	42.0
11	6930	48.0
12	6810	44.8

Considering the rather wide percentage variation shown in coercive force and bearing in mind that "the experimental evidence seems to point to the conclusion that there is one and only one set of mechanical characteristics corresponding to a given set of magnetic characteristics," it follows that certain of the above drills differ considerably from each other. The results of the magnetic test, if compared with the results of actual cutting tests, which have not been carried out on these drills, would afford information of considerable value.

Table II shows magnetic test results for a lot of carbon steel reamers, where the variation in values of coercive force from the mean is about 44 per cent.

TABLE II—MAGNETIC TESTS OF CARBON STEEL REAMERS

Specimen No.	Coercive Force
1	24.1
2	26.4
3	30.5
4	21.7
5	29.1
6	21.2
7	30.0
8	33.0
9	33.1
10	25.8
11	27.4
12	27.9

The development of apparatus for the magnetic analysis of materials has been signally backward when compared with the advances made in the general testing appliance field. This is true when the magnetic testing equipment is designed for use in what may be called purely electrical testing, where information in regard to the magnetic characteristics of materials is demanded in connection with the design of electrical machinery. It is equally true where information is desired as to the magnetic characteristics of materials or tools, in order to determine their quality or to predetermine their mechanical performance.

Until quite recently the difficulties in the way of making rapid and accurate magnetic measurements seemed insurmountable. The general problem of making

[2]Waggoner, "A Relation Between the Magnetic and the Elastic Properties of a Series of Unhardened Iron-Carbon Alloys," *Physical Review*, 35, pp. 58-65; 1912.

[3]Gumlich, "Magnetic Properties of Iron-Carbon and Iron-Silicon Alloys," Faraday Society *Transactions*, 8, pp. 93-114; 1912.

[4]Mars, *Stahl und Eisen*, 29, pp. 1673-1678; 1909.

[5]Burrows, "Correlation of the Magnetic and Mechanical Properties of Steel," *Bulletin*, Bureau of Standards, Vol. 13, p. 207. (Scientific Paper No. 272.)

such measurements centers about the determination of magnetic induction and the magnetizing force which produces this induction. The difficulties come in the determination of the magnetizing force. This force has a number of components, some of which may be calculated but others of which, due for example to the presence of joints in the magnetic circuit, may not. The presence of these joints demanded compensating adjustments for their offsetting, when the usual testing apparatus was employed, which made the test operation tedious and lengthy.

When therefore accurate magnetic test data was required the laboratory or shop had the choice of shaping their test material into a very long bar or into a closed ring, to obviate the joint difficulty, or else using a permeameter with complicated adjustments necessitating more or less skill on the part of the operator. The accurate testing of tools was usually out of the question. Most of the available permeameters which were simple in operation were notoriously inaccurate and could not be depended upon to give even comparative results save when the materials or specimens examined were practically of the same kind.

Notes on the Use of the Pressure Gage For Pitot-Tube Measurement

By Evald Anderson

IN MAKING use of the Ellison or similar differential pressure gages for the measurement of small differences of pressure, as with the pitot-tube in the determination of the velocity of gases in stacks and flues, a simple modification of the ordinary connections has been found of very great advantage.

As is well known the differences of pressure that must be dealt with in gas velocity measurement are ordinarily very small. Thus, the velocity-pressure corresponding to 12 ft. per sec. at 200 deg. C. and at sea level is only about .02 inches, or two of the smallest divisions on the ordinary gage. It consequently becomes very important that the zero reading of the instrument be always known with accuracy.

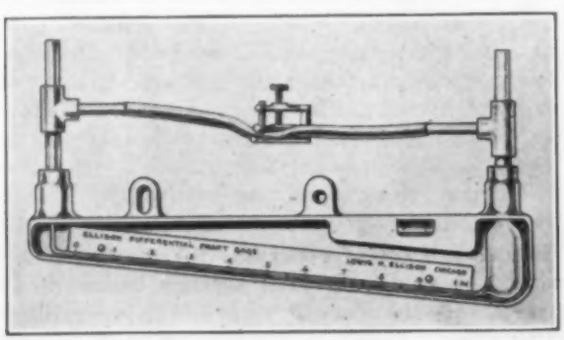


FIG. 1.—SKETCH OF ELLISON GAGE AND FITTINGS

This zero reading depends first on the volume of liquid in the gage, and second, on the alignment of the latter. The volume of liquid varies appreciably with the temperature of the exposed portion, while small variations in the alignment always occur from various causes. Neither of these variations introduce any appreciable error in the actual reading, provided the zero point is accurately determined, for the change in specific gravity of the liquid corresponding to the change in volume as represented by the movement of the meniscus of .01 is very slight, and the actual difference in level between any two given points on the gage is affected very little by a change of the alignment which would cause the liquid meniscus to move .01 in. On the other hand, if the actual zero reading is not known, such changes would introduce very large errors where the total pressure difference to be measured is of the magnitude of .02 in.

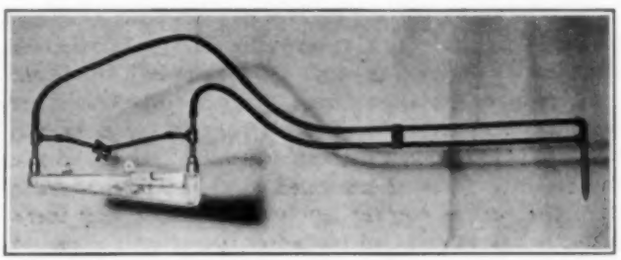


FIG. 2.—IMPROVED PITOT TUBE CONNECTIONS

When using the standard gage, the usual operation is to fit the gage with two pipe nipples, one in each opening, and then to connect these to the pitot-tube by means of rubber tubing. Then to find the zero reading, either the rubber tubing is disconnected from the nipples, exposing both sides of the gage to the atmospheric pressure, or else the pitot-tube is withdrawn from the stack or flue and held in still air, thus approximating equal pressure on both the velocity and static openings of the tube. Both of these schemes are unsatisfactory. In the first case it is nearly impossible to change the rubber-tube connections without disturbing the alignment of the gage, and in the second case eddy currents are nearly always present, even in so-called still air, which affect the gage-reading.

To overcome these difficulties the connections and fittings shown in the sketch, Fig. 1, and the photograph, Fig. 2, were devised some years ago and have been used continuously since then. These consist simply of two pipe tees and nipples connected with a rubber tube, with a tube-clamp to close this connection. The pitot-tube is connected to the upper nipples by means of rubber tubing in the ordinary way as shown. When the zero point is to be read, the tube-clamp is opened, equalizing the pressure on both sides of the gage. Of course this can be done without removing the pitot-tube from the stack or flue where the gas velocity is being measured. When the liquid meniscus has come to rest, the zero reading is noted, the tube-clamp closed, and the gage is ready for the regular velocity reading. If the velocity of the gas in the flue or stack is high, it is necessary to close one of the connecting rubber tubes by doubling it up between the fingers while making the zero reading in order to insure correct results.

With these connections the zero point can be determined as often as desired and accurate results thereby insured. In place of the fittings shown it is of course possible to use regular metal or glass connections fitted with a valve, instead of the rubber tube together with Hoffman clamp.

Laboratories of the Western Precipitation Company, Los Angeles, Calif.

The Remelting of Aluminium Pig in the Electric Furnace

Electric Melting Offers Advantages in Control of Atmosphere, Temperature and Application of Heat—Description of a Plant Which Replaced Oil Furnace—Comparison of Costs

BY DWIGHT D. MILLER
Engineering Department, The Society for Electrical Development, Inc.

IN VIEW of the great success attendant upon the use of the electric furnace in the steel industry, not only for melting and refining but also for the heat-treatment of the product as well, it is only natural that there should be a demand for an electric furnace by means of which the various metallurgical processes involved in the non-ferrous field could be carried on with the same accuracy, precision and duplication of results as has characterized its use in the steel and allied ferrous fields. That there is such a demand, together with its extent and the efforts that have been and are being made to meet it, has been pointed out in a paper by the writer: "The Electric Furnace as a Medium for Heating Non-ferrous Metals," read at the annual meeting of the American Institute of Metals last September.

ACCURACY OF CONTROL THE SALIENT FEATURE

Aside from the fact that the electric furnace has practically doubled the temperature range above zero and made it available commercially, the one great advantage secured by its use which has already established it firmly in the manufacture and conditioning of metals is summed up in the word *control*. Through no other heating medium can the same accuracy of control coupled with the nicety of adjustment and maintenance of temperature be obtained. In fact the electric furnace is pre-eminently suited for carrying out the various metallurgical processes in that by the very nature of its construction and operation it produces a non-oxidizing or reducing atmosphere.

The three vital factors involved in all metallurgical processes are atmosphere, time and temperature. Their accurate control and regulation is essential to the production of metals of the highest quality, and such control is best secured by the use of the proper type and equipment of an electric furnace.

ELECTRICAL CONTROL

We have just seen that control of atmosphere is inherently obtained in the electric furnace. Control of temperature is of even greater importance in processing non-ferrous than ferrous metals, since the additional danger of large metal losses due to volatilization on account of superheating is always present in the case of the former. Greater accuracy of temperature control and its regulation is secured when the electric furnace is used because of the peculiar nature of electric heat and the method of its application.

Electric energy is changed into heat at 100 per cent efficiency regardless of temperature and so applied that it is concentrated at definite points or confined within a definite area in the furnace; furthermore it can be generated in any quantity regardless of temperature, which feature is unique and renders its utilization more flexible, more efficient and the more readily controlled. On the other hand it is the lack of control of the various factors involved in the production of the heat itself as well as the nature of the appliances that renders the heat of combustion less flexible, less efficient and hinders its control.

In the one case electric energy is conducted, with but a slight loss, by means of overhead cables, which are pliable and readily portable to the exact location in which the heat is to be generated and there changed into heat without any loss by merely throwing a switch. With any given furnace, the electrical conditions, such as the line voltage, resistance of leads, electrodes, and resistor material are fixed so that the same amount of current must flow, producing the same temperature to an exact degree time and time again, and the only heat losses that must be taken care of are those due to radiation and conduction.

Moreover when it is necessary to change the temperature according to the requirements of the process it can be accurately varied in finely graded steps by voltage control—since in this case wattage is temperature.

COMBUSTION CONTROL

In the other case, liquid or gaseous fuel must be conveyed under pressure with an appreciable expenditure of

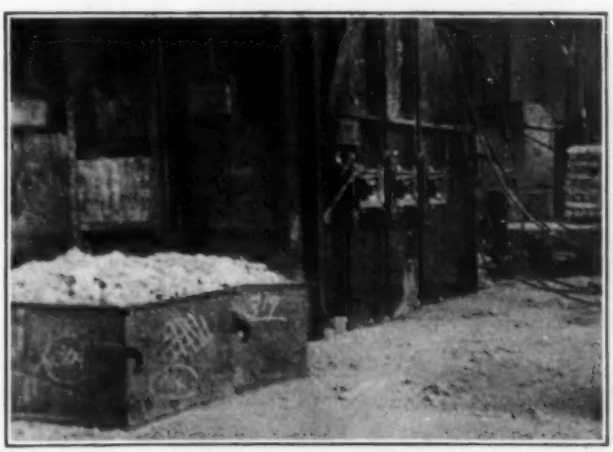


FIG. 1.—TAPPING TYPE OF STATIONARY FURNACE

energy in rigid, stationary pipe lines which are not portable and take up valuable space. If solid fuel is used, such as coal or coke, the case is all the more exaggerated. Upon arriving at the point of ignition the fuel must be mixed with the oxygen of the air before combustion takes place, but in order to get perfect combustion, so that there shall be 100 per cent efficiency, it must be

mixed with a definite minimum quantity of the oxygen of the air, a condition most difficult to control and rarely if ever encountered in commercial practice.

In fact statistics show that the average thermal efficiency of high temperature combustion furnaces as used in non-ferrous work is in the neighborhood of 7 per cent. The control of the degree of temperature as well as its gradations are much more difficult and complicated on

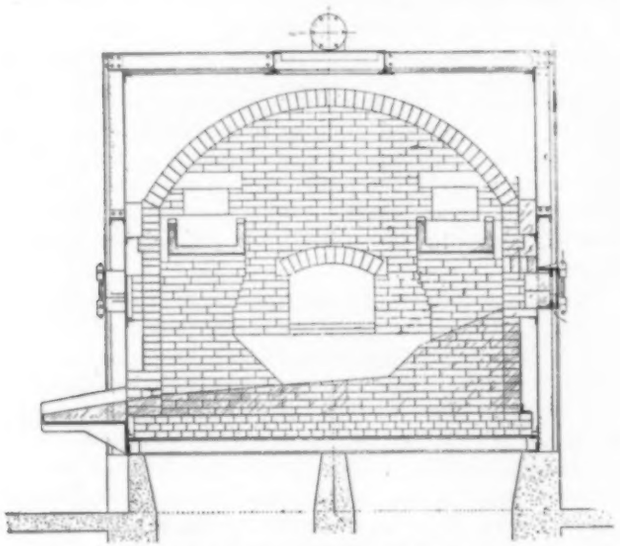


FIG. 2.—SECTIONAL ELEVATION OF FURNACE

account of the many variables involved as well as the errors of the human element always present with manual control. In addition to the heat losses due to radiation and conduction, there is the additional and greatest source of loss, i.e., heat lost by convection.

With natural draft, the draft is seldom known and not only changes from day to day but also often during each day in accordance with the variation in the direction and velocity of the wind and the humidity of the air. This condition is beyond human correction.

These advantages which are inherent in the case of electric heat more than offset its higher first cost in many instances. Many items enter into the entire cost of the finished product of which cost of heat is only one. If therefore by its use other items, such as time, labor and fire insurance, are cut in greater proportion producing a metal of higher quality—hence one commanding an increased selling price—it is evident that not only is electrically generated heat cheaper to use, but also its use is imperative in order to compete successfully with those using it in similar processes.

Aluminium Dross

Aluminium is not what is known as a volatile metal, it is however a very sensitive metal, absorbs impurities readily and has an affinity for oxygen, especially at high temperatures. This property has led to its use as a deoxidizing agent, since in combining with oxygen an aluminium oxide (Al_2O_3) known as dross is formed and can be skimmed off with the slag.

When melting aluminium pig—high-grade aluminium—if heated metal is allowed to come in contact with an oxidizing atmosphere, the loss due to dross may be as great as 5 per cent, since some of the elemental metal becomes entangled with the aluminium oxide during the process of skimming and is lost. Hence it is most important that the melting be done in a neutral or deoxidizing atmosphere.

Uses of Aluminium

With the large increase in the production of aluminium by the electric process has come naturally a greater demand not only for the pure metal but also for the aluminium alloys. One of its most important uses at present is found in the manufacture of parts for the timing devices used in connection with shrapnel. Aluminium for this purpose is usually sand cast under very high pressure, thus providing a denser metal as well as a metal with increased strength. Other important uses are found in the aëroplane and automobile industries, which use large quantities of both the pure metal and the alloys, the latter combining the lightness of aluminium with the strength of the alloying material such as steel. This property is especially valuable in the manufacture of aëroplanes in which human life is dependent upon the ability of the material to withstand successfully severe and repeated sudden stresses and strains. Still other uses for the metal are found in the manufacture of aluminium foil, bottle caps, tubing for store service, rolled rods and reinforced aluminium conductors.

Process at the U. S. Aluminum Company

About one-half of the total amount of aluminium used in this country is manufactured in the plant of the United States Aluminum Co., at Massena, New York. Here the pig metal as it comes from the reduction plant

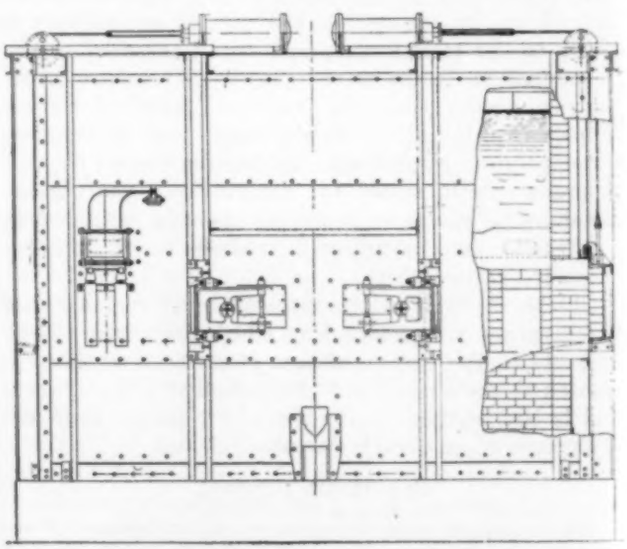


FIG. 3.—SIDE ELEVATION OF FURNACE

is remelted for the purpose of casting it into ingots or rolling billets. A number of aluminium alloys are also made and the metal heat treated in the electric furnace after having been rolled or drawn into rods or conductors. The object of this remelting is to cleanse the metal by removing in this manner the slag and scum contained from the reduction process. After the remelting there is a distinct and marked difference in its appearance, as it loses its dull finish and is much brighter.

Since a very great quantity of aluminium is handled at this plant, even the smallest saving in metal loss is important and soon manifests itself in the aggregate

savings. Hence, with the idea of experimenting with just what could be done in the way of affecting savings as well as in improving the quality of the metal, the United States Aluminum Co. installed electric furnaces both for remelting and heat treating the metal.

The Furnace

The furnace selected for remelting is a stationary resistance type and has a bowl shaped hearth capable of holding three to four tons of molten metal which is discharged by tapping. It is rated at 500 kw. and designed for single-phase, 25-cycle operation.

The enclosure is rectangular and made of sheet metal suitably insulated with high-grade fire clay bricks and backed up with heat insulating material in the space between them and the metal shell. There are doors at either end of the furnace together with three rabbling doors on the side opposite the tap hole. These doors are heat insulated in the same manner as the body of the furnace. Those at the ends are opened and closed by sliding up and down vertically, being actuated by compressed air. The rabbling doors swing open on hinges. Running lengthwise with the furnace along either side are resistor troughs also rectangular in section but open at the top, made of highly refractory carbide mixed with a binder so that they can be easily molded. They are filled with resistor material consisting of finely broken carbon or graphite and supported on separate brick piers which serve to dissipate the heat generated in the troughs and diffuse it uniformly, thus avoiding hot spots in the refractory lining in the immediate vicinity of the troughs. Current enters the troughs through large copper terminals attached at the ends, making contact with the resistor material which becomes incandescent throughout in the same manner as the filament of an incandescent lamp. The heat thus generated is radiated mainly to the furnace roof and from there reflected down on the hearth and the material being treated.

Such construction provides a simple, durable and strictly commercial furnace, since all material used can be readily obtained in the open market; one in which both the atmosphere and temperature is under positive and accurate control.

When running continuously the furnace can melt one ton per hour which is tapped into graphite crucibles holding about 125 pounds. The daily output of the furnace is twenty tons.

Electrical Equipment

Single-phase 25-cycle current enters the building at 2200 volts and is there stepped down to 500 volts, at which pressure it enters the primary side of a special regulating transformer always provided with the furnace. This transformer consists of 9 selective, oil-break, hand-operated switches by means of which the temperature is regulated and held constant by voltage control. The actual voltage required varies with the resistance of the resistor material in the troughs and the required degree of temperature of the material being processed. That actually used in the furnace ranges from 500 down to 240 volts.

In addition to the usual operating main line switch, there is an indicating and integrating wattmeter, also a pyrometer mounted on the switchboard. This pyrometer is connected to a thermocouple which protrudes through the roof well into the furnace. Hence an accurate record is had at all times of the amount of power being consumed, the total consumed each day as well as the degree of temperature attained.

Operation

Upon closing the main line switch, current at full operating pressure flows through the resistor material. Due to the negative temperature coefficient of this material (broken carbon or graphite), it is a poor conductor when cold and offers resistance to the passage of the current at the start. This resistance transforms the electrical energy into heat, and the resistor material begins to heat up. The hotter it gets the better electrical conductor it becomes, and more current flows, soon raising the material to an incandescent heat. Any tendency to overpower the furnace is immediately indicated by the wattmeter on the board and quickly corrected by connecting one of the selective oil-break switches which lowers the voltage and checks the power input. There is a slight voltage fluctuation during this heating-up period, but as soon as the troughs have attained the desired temperature the resistance of the resistor material remains practically constant and the current flow automatically adjusts itself to a steady inrush. The special regulating transformer is also used to secure accurate adjustments in the degree of temperature in accordance with the requirements of the material under treatment.

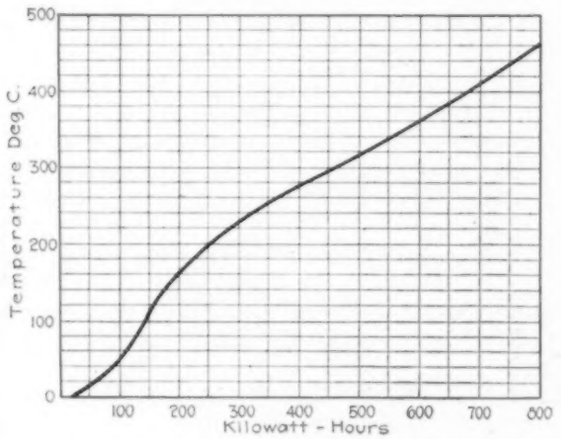


FIG. 4.—POWER CONSUMPTION CURVE

Characteristics of the Furnace

Curves are here given showing the power input necessary to bring the furnace up to operating temperature, also the rate of cooling. These curves apply to a 50 kw. annealing furnace in use at the plant, but of the same electrical design and construction as the melting furnace. It will readily be seen from the cooling curve that having once attained temperature, the furnace retains the heat to a remarkable degree—in other words is sluggish. This characteristic is used to great advantage in keeping down the amount of power required to carry on the process, especially under continuous operating conditions as is here the case. For instance, with the furnace full of molten metal, the pyrometer indicating a

temperature of 1050 deg. C. (1922 deg. F.), which means that the bath was about 850 deg. C. (1562 deg. F.), on account of the temperature head between roof and bath, this temperature was maintained constant with the regulating transformer on only the fourth step and an input of 265 kw., and this under the condition of continuous addition of cold metal as the hot metal was tapped from time to time. In another plant where the

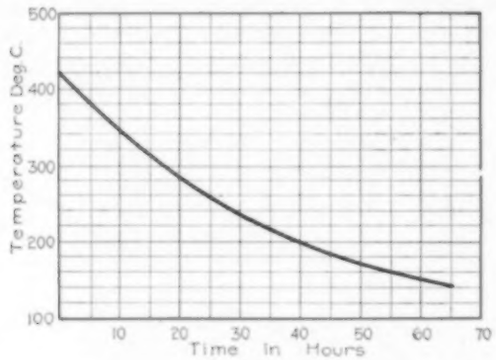


FIG. 5.—RATE OF COOLING

furnace is operated intermittently they make the last heat of the day on practically the stored energy of the furnace.

After the metal is tapped it is cast into ingots or rolling billets and either sold to the trade or further worked in the plant.

The castings are subjected to a pressure of 25,000 pounds per square inch by means of molds operated by a horizontal hydraulic ram. This ram is situated in the center of the press with the molds on either end of the shaft. As the pressure is exerted on one set of molds the others are opened and the castings removed.

Several kinds of alloys, some containing zinc, are also made in the plant, and it is in this process that the greatest savings are made by the use of the electric furnace. Metal losses due to an oxidizing atmosphere as well as those due to volatilization and the carrying off of fine particles by convection currents, which in some cases is the greatest source of loss, are entirely eliminated. In fact, it is the possibility of the elimination of just such losses as these that is rapidly establishing the electric furnace in the same position in the non-ferrous field as it now occupies in the ferrous industries.

ANNEALING

In order to relieve the metal of the stresses and strains produced in working it, also to further develop the inherent physical characteristics of the alloys, some of the product is annealed in an electric furnace of the same general type as that used for melting.

It is now a well recognized and established fact that heat treatment contributes more to the superior physical qualities contained in various alloys than does the addition of the alloying elements.

The annealing furnace is known as the car type and while originally rated at 50 kw. it is often worked with a power input of 100 kw. The platform of the car is made of fire-clay brick, on which the material to be treated is loaded in such a manner as to allow of free circulation of the radiated heat around all parts of the charge and its even penetration.

The loaded car is run in and out of the furnace, which has only one door, on tracks, being actuated by motor-driven gearing located beneath the floor.

The capacity per hour of metal treated as well as the time it is left in the furnace together with the degree of temperature used will depend upon the material being processed. The temperature generally used however varies from 350 to 500 deg. C. (662 to 932 deg. F.) and the time from two to five hours.

The furnace is also equipped with a special regulating transformer, switches, wattmeter and pyrometer so that the same degree of accuracy of control and recording of conditions at all times is had as is the case with the remelting furnace.

A curve is here given showing the time required to anneal different amounts of aluminium with a steady input of 50 kw. per hour starting with a hot furnace 425 deg. C. (797 deg. F.) which is held constant.

RESULTS OBTAINED

The advantages which are secured by the use of the electric furnace are summed up by Mr. H. M. Hall, Superintendent, as follows:

1.—The electric furnace replaced an oil furnace burning crude petroleum oil which produced large losses, particularly in the case of alloys containing volatile constituents such as zinc.

2.—The electric furnace gives much more uniform mixtures with much less losses.

3.—The cost of electric power compares very favorably with the increased cost of fuel oil which was becoming prohibitive.

4.—Savings are effected by the use of the electric furnace in that the metal losses are less and the thermal efficiency greatly increased.

5.—Where coal fired furnaces are used, there is a saving of one or two men in favor of the electric furnace.

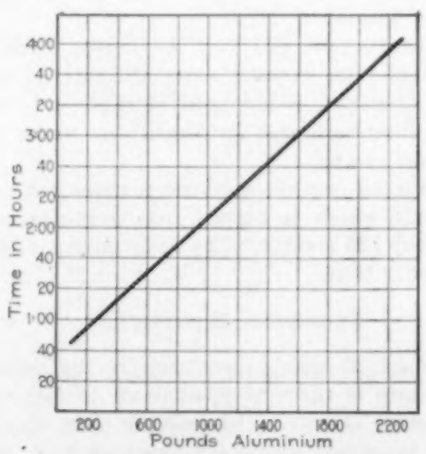


FIG. 6—ANNEALING TIME

6.—There is also a saving in space required per pound or ton of metal melted in favor of the electric over the coal fired furnace.

7.—The electric furnace is a much cleaner, cooler furnace for the men to work around than is the case with an externally fired fuel furnace.

It is evident that while improved quality of product was the end sought, economy of operation resulted from the use of electricity as the heating medium.

Synthetic Phenol*

Description of Old Process Used Prior to Introduction of Dennis-Bull Process—Great Economies Effected in Use of Sulphuric Acid and Caustic Soda as Well as in Transportation of Raw Materials

By A. G. PETERKIN

IT IS difficult to estimate the quantity of any of the products from coal tar which are available, because on the one hand the production of tar is changing from day to day, due to the continued increase in the number of coke ovens, and on the other hand its consumption for fuel purposes is affected by greater or less difficulty in obtaining supplies of coal. It is safe to say, however, that it would not be practical or even possible to-day to make more than five to six million pounds of phenol per year from this source.

The United States used before the war some 5,000,000 lb. of phenol per year, the consumption being divided between pharmaceuticals, resins of the Bakelite type, dyestuff intermediates, and the explosive, picric acid. At the beginning of the war the demand immediately increased, due to the increased manufacture of picric acid. The French Government particularly became a large customer of manufacturing concerns in this country, both for phenol and picric acid. The production just before the entrance of this country into the war had jumped to something like 72,000,000 lb. of phenol per year.

It is likely that 1919 will see a very great increase in the production of phenol in this country. Coal tar as a direct source of phenol is therefore a negligible factor in view of the present demand.

Whatever the merits of picric acid as an explosive, a real objection to its manufacture in such times as these lies in the relatively enormous amount of raw materials involved, and the necessity for the correspondingly great consumption of our valuable transportation facilities. For example, to make 100,000,000 lb. of synthetic phenol requires in round numbers:

	Pounds
Benzol	115,000,000
Fuming Sulphuric Acid (9½%)	280,000,000
Caustic Soda	180,000,000
Lime	42,000,000
Limestone	190,000,000
Coke	35,000,000
Niter Cake	42,000,000
Total	884,000,000

or nearly nine times that of the finished product, using the generally adopted process and working with fair economy. To say that it is an extravagant process is to put it mildly, but it has maintained itself with considerable obstinacy in the face of many attempts to improve and shorten it.

Outline of Old Process

The illustration, Chart I, shows the old process diagramatically. It has been described many times, and a bare outline will suffice now. Benzol is sulphonated at temperatures varying from 50 to 70 deg. C. The strongest acid that may be used with economical results in the writer's opinion is fuming sulphuric acid containing 9½ per cent of free SO_3, the limitation being enforced by the necessity of avoiding the formation of diphenyl-sulphone. Since the composition of the spent acid from the sulphonation is a constant, the amount of sulphonic acid necessary for the completion of the reaction is increased very largely as the concentration of the initial acid is decreased. It has, therefore, not been considered economical to use acid weaker than one containing 98 per cent H_2SO_4. The figures given above are for the higher concentration. The result of the sulphonation is a solution of sulphonic acid, sulphuric acid and water. The sulphuric acid and water together make a spent acid of approximately 80 per cent H_2SO_4 and 20 per cent H_2O. The solution then contains in round numbers 60 per cent sulphonic acid and 40 per cent spent sulphuric acid. The sulphonic acid is required in the form of sodium salt.

The procedure in all plants is essentially the same, although many minor variations have been adopted. Slaked lime is placed in the agitators and the mixture of sulphonic and sulphuric acid slowly added during agitation. The sodium salt may be formed by addition of sodium sulphite obtained from the fusions later in the process. When this procedure is adopted, the mixture in the agitators consists of a water solution of sodium benzene sulphonate and a mixture of solid calcium sulphite and calcium sulphate. The whole is heated to 115 deg. C. in order to obtain the sulphate in proper crystalline form for filtering, and is passed through the filter presses. The resulting solution of sodium benzene sulphonate contains approximately 12 per cent of the salt and small quantities of calcium sulphate, due to the slight solubility of this material.

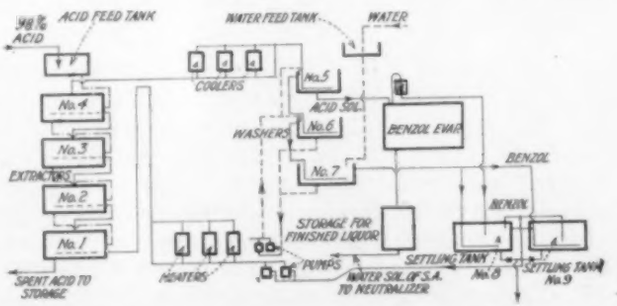
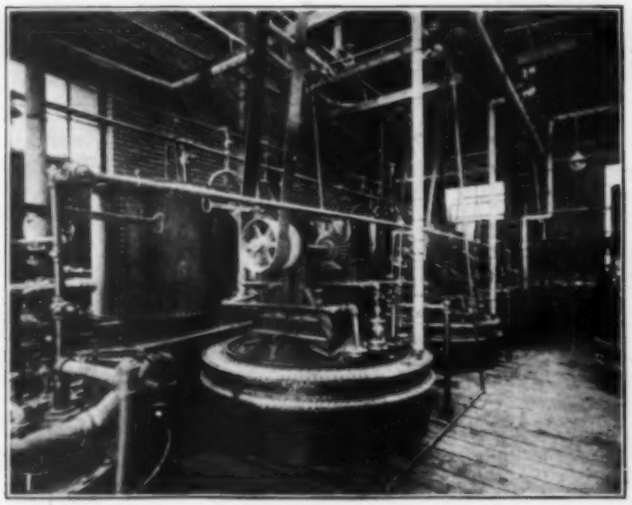
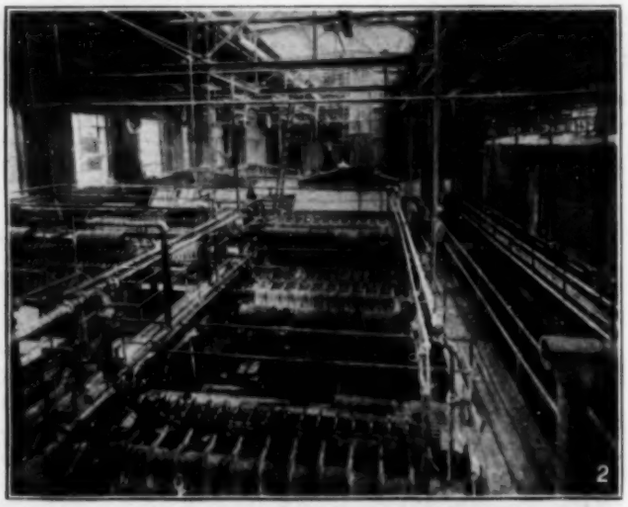


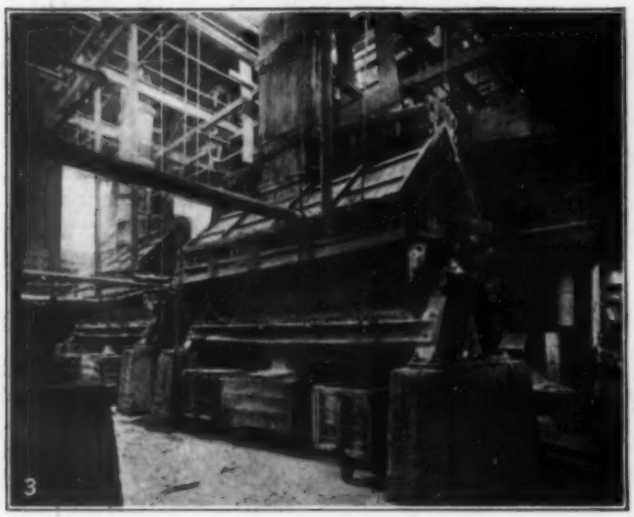
CHART I.—OLD SYNTHETIC PHENOL PROCESS

It is important to remove all calcium salts, both for the sake of the tubes in the evaporators and because of the havoc they cause in the fusion operation. This is accomplished by the addition of the necessary small amount of sodium carbonates and refiltration. Some

*A paper read at the meeting of the Amer. Inst. of Chem. Eng., Gorham, N. H., June 19-22, 1918.







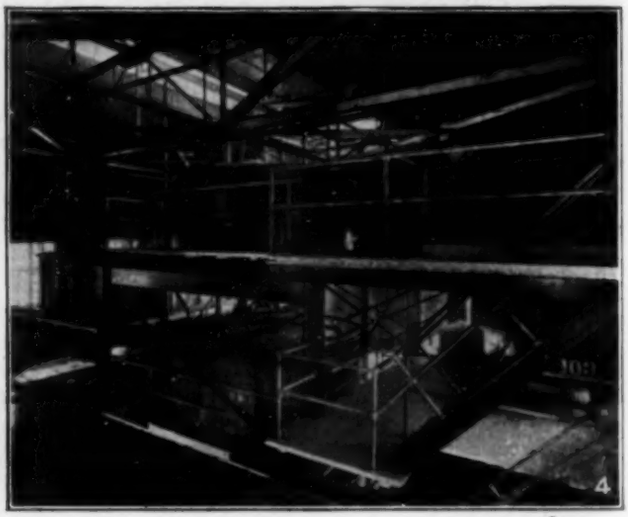


FIG. 1.—SULPHONATORS, TOP VIEW
FIG. 3.—DRUM DRYERS

FIG. 2.—FILTER PRESSES
FIG. 4.—GENERAL ARRANGEMENT SPENT ACID PLANT

factories make the soda salt in two steps, adding sodium carbonate to the filtered solution of calcium benzene sulphonate; others add only the amount of lime necessary to react with the sulphuric acid, in making the soda salt in one step, which makes the use of the by-product sulphite difficult, due to the liberation of SO_2. The 10 per cent solution is evaporated down to the saturation point, and the salt obtained from the syrup by means of drum dryers. The salt, preferably retaining about 10 per cent of water, is fed into melted caustic soda in the fusion kettles, there being about one molecule of soda in excess. The temperature during the fusion is maintained between 320 and 350 deg., the salt being fed in slowly during the operation.

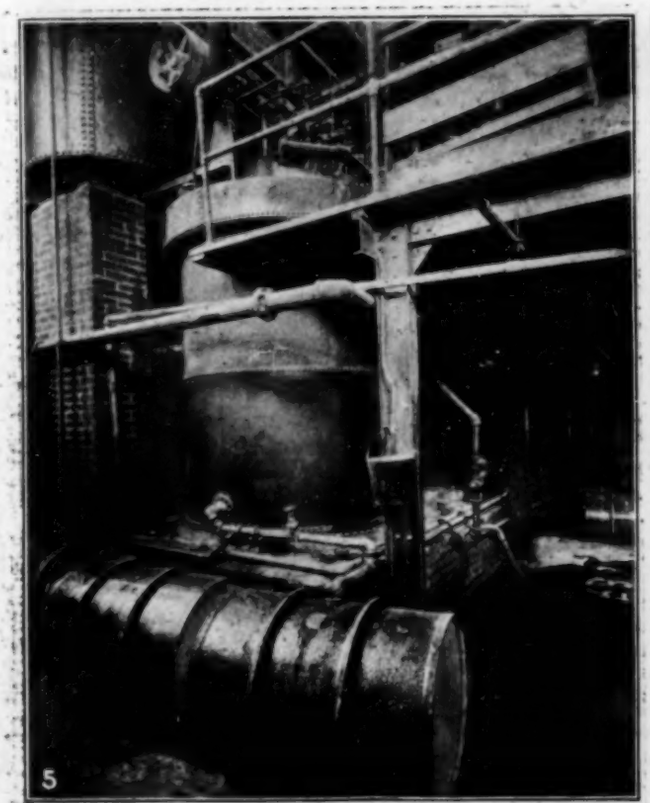
The critical temperature of the reaction appears to be 320 deg. C. As the result of the fusion, a light brown liquid mass with the appearance of melted chocolate is obtained, which is poured hot into such an amount of water as will dissolve the phenolate and leave the sodium sulphite in solid form. This is done in vessels marked "dissolvers" which are provided with stirrers. Only about 10 per cent of the sulphite formed remains in the solution and this amount can undoubtedly be decreased. The phenolate liquor is filtered from the sulphite on open sand filters. The sulphite is agitated with water, separated by means of filter presses, washed free of phenol and marketed as an impure sodium sulphite. A typical analysis of this material is:

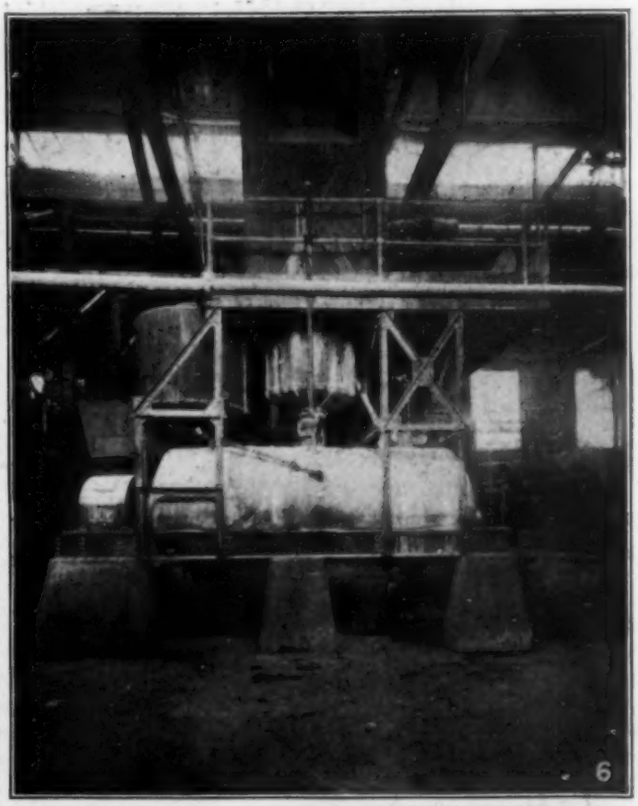
	Per Cent
Moisture	24.20
Na_2SO_4	7.12
Na_2SO_3	62.30
Insol. in hot H_2O	0.46
C_6H_5ONa	0.60

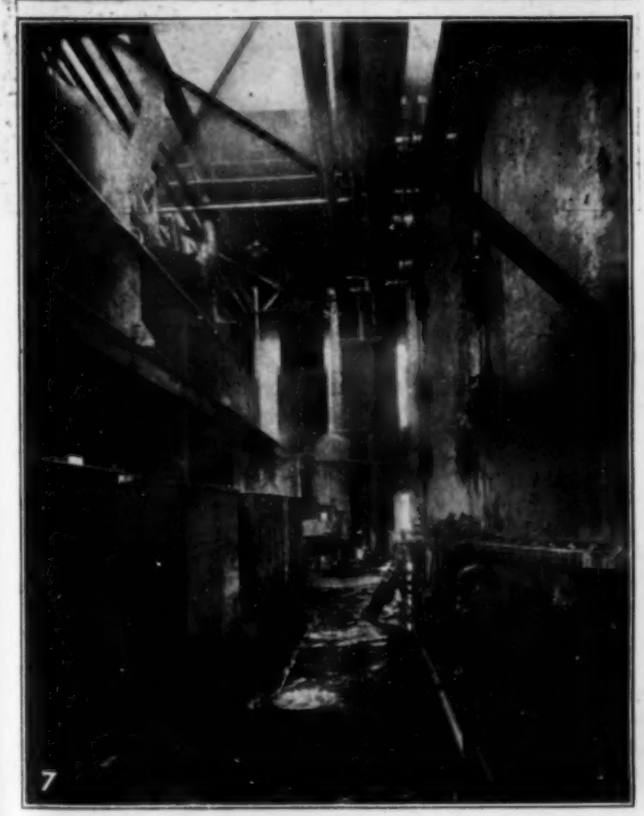
The wash water is used in the dissolvers so that its sulphite is deposited again on the filter beds.

The phenolate liquor is carefully diluted to a gravity corresponding to a phenol content of about 16 per cent. This diluted solution is placed in a series of tanks, and 30 per cent carbon dioxide gas generated from a mixture of coke and limestone passed through it. These so-called "blowers" are arranged so that the gas may pass from one to another in any direction desired. The strong gas goes first through the almost neutralized phenolate and leaves from a strongly alkaline solution, thus avoiding any possibility of loss due to the vapor pressure of phenol at the temperature of the spent gases involved which is about 50 deg.

It is impossible to entirely neutralize the phenolate solution by means of carbon dioxide in one operation, at any rate, unless such a large excess of CO_2 is introduced as to transform all the carbonate to bicarbonate, which is undesirable. When the passage of the gas is







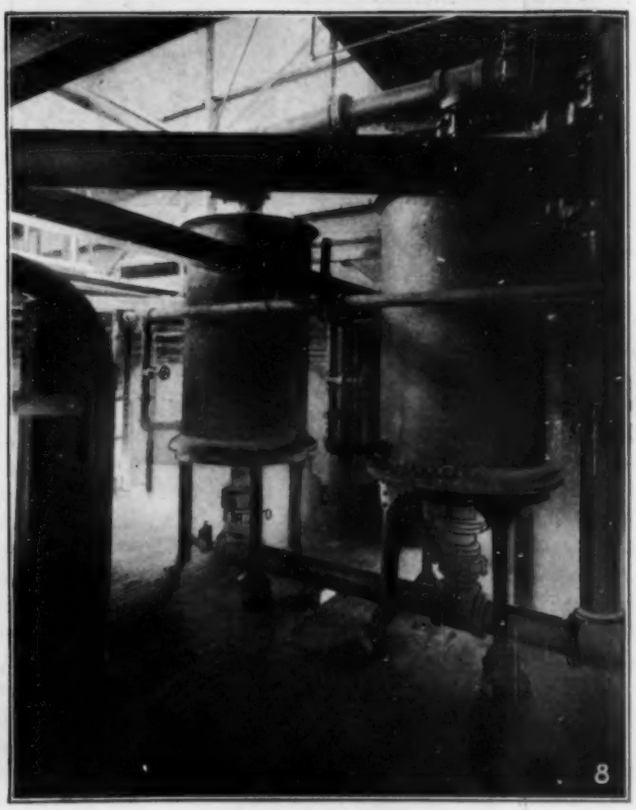


FIG. 5.—SULPHONATORS, SIDE VIEW
FIG. 7.—EVAPORATORS AND DISSOLVERS

FIG. 6.—AGITATORS
FIG. 8.—COOLERS

discontinued the phenol layer contains in solution about 10 per cent phenol as sodium phenolate, while the carbonate layer is free from phenolate but contains approximately 2 per cent of phenol. The carbonate is completely freed from phenol by means of a steam distillation; a 4 per cent solution of phenol is obtained in this way. The crude phenol containing 10 per cent of phenolate may be completely acidified with CO_2 by replacing the carbonate solution with water. Niter cake, however, used as an acidifying agent has the ad-

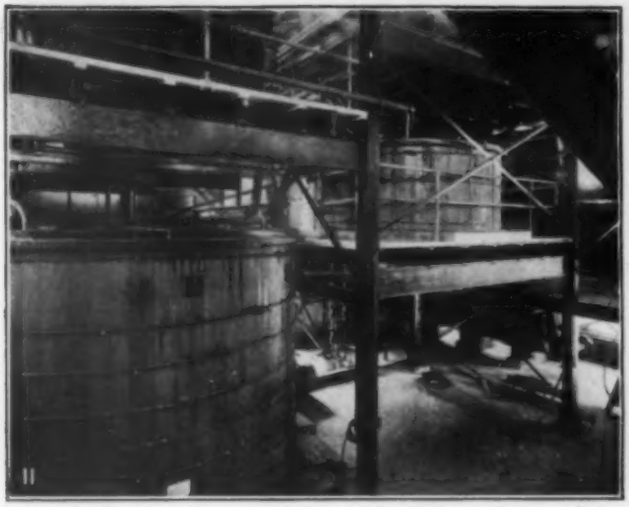


FIG. 9.—RECORDING GAGE, AUTOMATIC TEMPERATURE CONTROL
FIG. 11.—FINAL WASH TANK AND RECEIVER

FIG. 10.—WASHERS
FIG. 12.—TWO SMALL PUMPS ONLY REQUIRED IN THE PROCESS

vantage of simultaneously removing a large percentage of the water present. The dehydration reduces the water content of the crude phenol from 30 to less than 14 per cent and relieves the refining stills of a great burden. The crude acid is placed in a simple still from which is obtained a first fraction of water and phenol, a middle fraction of pure phenol and a residue of the more complex phenolic bodies formed in the fusion. The synthetic phenol produced is exceedingly pure; it is comparatively easy to obtain material melting at 40 deg. C. Redistillation gives a product melting at 40.6 deg. The true melting point of pure phenol is in our opinion 40.8 deg.

Economies to be Effected in the Process

The great economies possible in the process are obviously to be made in the cutting down of the 100 per cent excess of sulphuric acid, the reclaiming of the caustic soda and the marketing of the sodium sulphite in a useful and valuable form. The maximum yield which has been claimed for the process is about 80 per cent. Our work has shown that the fusion operation alone will not give more than 90 to 92 per cent of the theoretical yield; in practice it is difficult to maintain this high standard. Under present conditions, the average American practice probably results in a total overall yield of between 60 to 75 per cent. As chemical processes go, the process requires an inordinate amount of labor and the repeated handling of the material gives ample opportunities for mechanical losses, particularly in view of the present restlessness of workmen.

Two methods have been suggested to reduce or conserve the excess of sulphuric acid used. Daniel Tyrer of England (U. S. Patent, No. 1,210,725) passes benzol vapor through sulphuric acid of as low concentration as 90 per cent H_2SO_4 at temperatures varying between 100 and 185 deg. C. That part of the benzol vapor not reacted upon carries with it to a condenser the water of reaction, and so gives a constant concentration to the sulphuric acid, keeping it active. Tyrer claims in this way to get about 80 per cent of the amount of sulphonic acid theoretically obtainable from the sulphuric used. This method has not yet been tried on a large scale in this country.

Method of Dennis and Bull

The second method is that of Dennis and Bull, the practical application of which has been worked out by the Barrett Company. Some two years ago, Professor L. M. Dennis[1] at Cornell University discovered that al-

[1] U. S. Patents, Nos. 1,212,612, 1,211,923, 1,227,894, 1,228,414 and 1,229,593.

though the solubility of pure sulphonic acid in benzol was negligible, benzol would take up from the mixture of sulphuric and sulphonic acids between 2 and 3 per cent of its own volume of the sulphonic acid. In working out this idea it occurred to Mr. Hans Bull[3] of that company that the sulphonation could be made simultaneously with the extraction. These ideas have been utilized in the evolution of an extremely simple process which not only saves 90 per cent of the excess sulphuric acid as a spent acid containing 70 to 77 per cent H_2SO_4, but eliminates a good percentage of labor, all the lime, and substantially reduces the deplorable cost of repairs, due to the many moving parts of the old installation.

The process will be easily understood from Chart II. The vessels 1, 2, 3 and 4, so-called "extractors," contain at rest a layer of a solution of sulphonic and sulphuric acids of varying proportions. The benzol passes continually upward through this series of extractors, the vessels being under a pressure equivalent to the head of benzol. The distribution of the liquid in fine bubbles is effected by means of perforated branch pipes. After the passage of the benzol for a certain length of time, the solution in No. 1 is free from sulphonic acid and consists of 77 per cent H_2SO_4. When this has been accomplished, the so-called "spent acid" is withdrawn. The solution in No. 2, which probably contains 10 per cent of sulphonic acid is dropped into No. 1. The solution in No. 3, which contains probably 25 per cent sulphonic acid is dropped into No. 2, and the solution in No. 4, which contains probably 40 per cent sulphonic acid is dropped into No. 3.

Into No. 4 is then slowly introduced a charge of 98 per cent sulphuric acid. The flow of benzol is not interrupted at any time. Sulphonation takes place almost immediately and the volume of the benzol flowing through, approximately 200 gallons per minute, is so great as to effect almost instantaneous removal of the heat of reaction. The benzol is maintained throughout at a temperature of 60 deg. C. by heaters at the bottom of the system and coolers at the top.

After passing through the coolers, the benzol, which will contain approximately 2 per cent sulphonic acid, passes successively through the washers, 5, 6 and 7, containing water. The benzol falls from one vessel to another by gravity, there being no pressure on this part of the system. The sulphonic acid remains in the water and the benzol leaves the last washer entirely relieved of its burden. It is passed to large settling tanks where the rate of flow is slowed down to such an extent as to allow the sulphonic acid solution, carried in suspension, to settle, and from these tanks flows to the pump and is forced through the heaters to the extracting system once more.

When such an amount of sulphonic acid has been deposited in Washer No. 5 as to bring it to the strength desired, it is removed to an evaporator and the solution from Washer No. 6 pumped to No. 5, and that from No. 7 to No. 6. Fresh water is put into No. 7. A water solution of sulphonic acid can be obtained containing 60 per cent or even more sulphuric acid and containing also about 2 volumes per cent of benzol in solution. The benzol is removed by evaporating a small percentage of the water. The solution of sulphonic acid is then neutralized, either by the carbonate solution from the phenol blowers or with the solid sulphite of soda. The sodium benzene sulphonate obtained contains some 5 or 6 per cent of sodium sulphate, due to

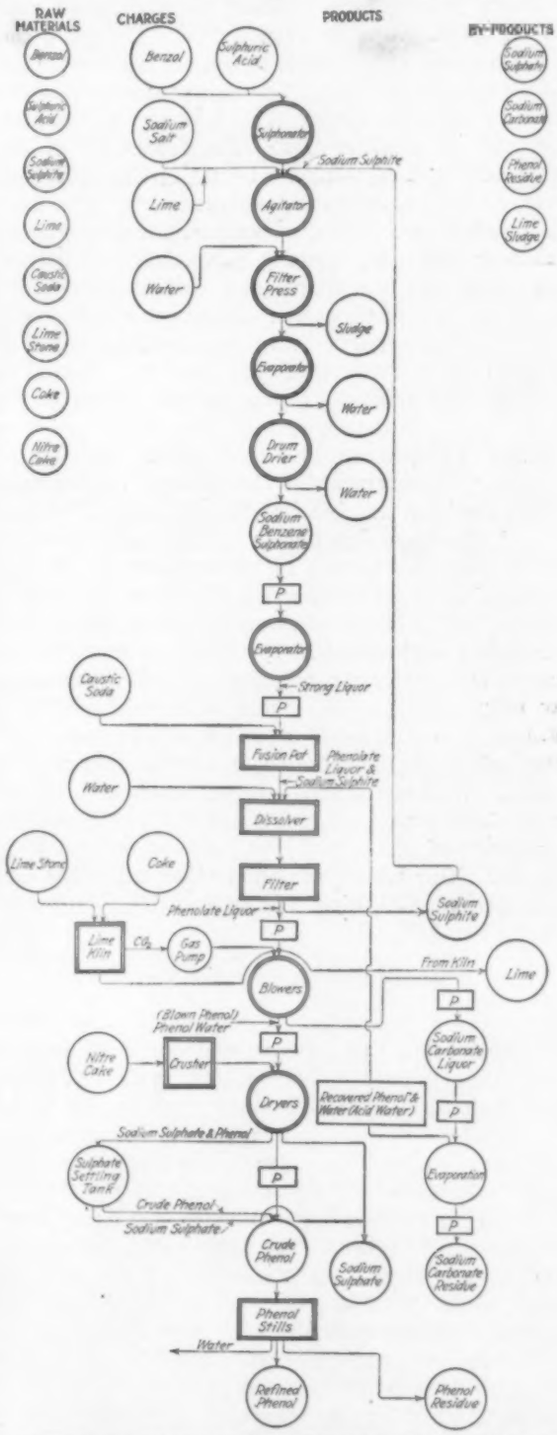


CHART II.—FLOW SHEET, DENNIS BULL PROCESS

the solubility of sulphuric acid in the benzol solution of sulphonic acid (one part sulphuric to twenty parts sulphonic).

Advantages of the Process

The advantages of the process are obvious. The initial cost of the plant is about 50 per cent of that of the old style plant, which it displaces. Moreover, it runs practically without attention and requires from one-third to one-fourth the number of laborers. Tak-

[3]U. S. Patents, Nos. 1,247,499 and 1,260,852.

ing for granted complete extraction of the sulphonic acid, which proves quite possible, and a removal of the benzol from the water solution of sulphonic acid, the losses possible are confined to mechanical causes, that is, either leaks or evaporation. The yield under the old process, from benzol to sodium benzene sulphonate, is about 90 per cent. The new process makes easily possible a yield of 98 per cent, leaving the mechanical losses out of consideration. The formation of disulphonic acid and of sulphone is negligible. The operations: (1) discontinuous sulphonation, (2) liming, (3) filtering, and (4) evaporating, involving complex machinery and many moving parts, have all been displaced with the one simple and continuous operation, extraction and sulphonation going on simultaneously, the only moving parts being two small pumps. The enormous simplification of the process achieved will be made more evident by photographs shown in Figs. 1 to 12 than by any description. The spent acid is concentrated to 93 per cent and used repeatedly.

Another improvement in the process very generally adopted has been the so-called "liquid fusion," by means of which the drum dryer with its dust and spatter has been eliminated. Liquid fusion consists in the introduction of a saturated solution of sodium benzene sulphonate directly into liquid caustic soda at a point above the reaction temperature. The reaction, when the temperature is properly controlled, goes even more smoothly than with the solid, since there is no tendency to dust and float, and the rapid evolution of the steam gives better agitation. The fusion is a great source of loss in yield. Well conducted fusions, where the temperature has been kept down and which for that reason show no evidence of oxidation, give between 86 and 90 per cent yield. Our experience shows that using the liquid fusion method, a high yield is more easily obtained than with the dry salt.

Economy of Caustic Soda

So much for innovation. Another important economy to be achieved in this process, and one even more important than that of sulphuric acid, is that of caustic soda. Neutralizing the phenolate with sulphuric acid, as is often done, is a gross and inexcusable waste. Providing that the lime can be utilized, the difference in cost between the neutralization with CO_2, as generated from limestone, and with sulphuric acid is immeasurably in favor of the former and the operation is exceedingly simple, once the necessity for clear solutions is understood and the fact of the solubility of phenolate in phenol recognized. If any salts are precipitated by the carbonation of the phenolate, an emulsion is obtained from which the phenol will settle only with great difficulty. The avoidance of this emulsifying is merely a question of dilution, however, and no real obstacle is involved. The soda, not only of the phenolate, but the excess soda, is gotten in the form of a weak solution of sodium carbonate, which can be readily causticized and made available for the fusion operation.

The fusion reaction is:

$$C_6H_5SO_3Na + NaOH = C_6H_5ONa + Na_2SO_3 + H_2O.$$

If half of the sulphite is used for the formation of the soda salt, only one molecule of soda is consumed and this goes out of the plant in the form of sodium sulphite, a useful and marketable product. Since in the Barrett process SO_2 is evolved from the neutralization of the sulphonic acid, it is possible also to produce bisulphite of soda.

The large amount of limestone needed is not a relatively important objection from the point of view of cost, but it presents a transportation problem of considerable magnitude. The disposition of the calcium carbonate sludge from the causticization may, and in our case does, involve considerable expense. From the point of view of transportation alone, the calcination of the carbonate sludges, in rotary kilns, as a source of CO_2 and of lime is justified. This has been successfully tried in connection with other operations and has been found economical in districts somewhat remote from the limestone fields.

The various economies indicated will result in a startling decrease of raw materials:

	Per Cent
Sulphuric acid	40,
Caustic soda	60,
Lime	90,
Limestone	100,

and a corresponding decrease of tonnage to be transported from a total of 884,000,000 to 397,214,400, per million pounds of phenol, or about 50 per cent.

Paint Thinning Calculations

In producing a standard weight per gallon of paint or varnish mixture, the cross subtraction scheme is valuable, because of being easily remembered as well as giving accurate ratios readily. For example, if an eight pound to the gallon paint is desired, the materials to be mixed being 20-lb.-gal. paste and 7.5-lb.-gal. linseed oil, then:

$$\begin{matrix}\text{(Paste)}\ 20 \\ \text{(Oil)}\ 7\tfrac{1}{2}\end{matrix} \Big\rangle\ 8 \Big\langle \begin{matrix}\tfrac{1}{2}\ \text{gal.} \\ 12\ \text{gal.}\end{matrix}$$

The gallon weights, 20 for paste, 7½ for oil and 8 for the desired mixture are set down as in the above and the differences taken as the equations indicate, no attention being paid to positive or negative signs. The differences ½ and 12 are the ratio numbers. Thus, to every half gallon of paste, twelve gallons of oil must be added, in order to obtain an 8-lb.-gal. paint. Now if a ton of 8-lb.-gal. paint is desired, 250 gallons must be made, the ratio ½ to 12 or 1 to 24 requiring for this mixture 10 gallons of 20-lb. paste and 240 gallons of 7½-lb. linseed oil. If it is desired to thin this paint to 7 lb. 15 oz. with spirits of turpentine (7.2-lb.-gal.) or naphtha (6-lb.-gal.) each calculation is as follows:

$$\begin{matrix}\text{(Paint)}\ 8 \\ \text{(Turpentine)}\ 7.2\end{matrix} \Big\rangle\ 7.94 \Big\langle \begin{matrix}0.74\ \text{gal.} \\ 0.06\ \text{gal.}\end{matrix}$$

$$\begin{matrix}\text{(Paint)}\ 8 \\ \text{(Naphtha)}\ 6\end{matrix} \Big\rangle\ 7.94 \Big\langle \begin{matrix}1.94\ \text{gal.} \\ 0.06\ \text{gal.}\end{matrix}$$

So that the gallon ratio of paint to thinner would be 74: 6 and 194: 6 respectively. As two hundred and fifty gallons of 8-lb.-gal. paint are to be thinned; the gallons of thinner to be added would be:

$$\text{Turpentine,}\ \frac{250}{74} \times 6 = 20.27\ \text{gal.}$$

$$\text{Naphtha,}\ \frac{250}{192} \times 6 = 7.8\ \text{gal.}$$

As the pigment concentration is a function of the gallon weight, it is considered good practice to regulate paint mixture by gravity as well as by viscosity tests.

Synopsis of Recent Chemical and Metallurgical Literature

Tin-Wolfram Concentrators.—*Chemical Engineering and Mining Review* for December, 1917, contains an article by JOSEPH MILLER on the concentrator at Storey's Creek, Tasmania, and the issue for June 5, 1918, contains similar information on Butler's Tin Mine, Torrington, N. S. W.

The Storey's Creek ore contains massive, easily detached, wolframite and cassiterite, amenable to hand picking. Their mill, of a capacity of 30 tons per eight hours, is shown in the diagram (Fig. 1) which requires no elaboration, except as to the table section. The concentrates from the three coarse tables are treated in a hydraulic cleaner, which eliminates the fine pyrite, and the overflow is retreated on the slime table. The middlings are re-treated, being fed by water jet when poor ore is being sent to the mill. Overall recoveries are said to be above 85 per cent. The concentrates are treated in two Thompson-Davies electro-magnetic separators. Classification, like drying, is absolutely necessary as a preliminary to this step. The screen classifier

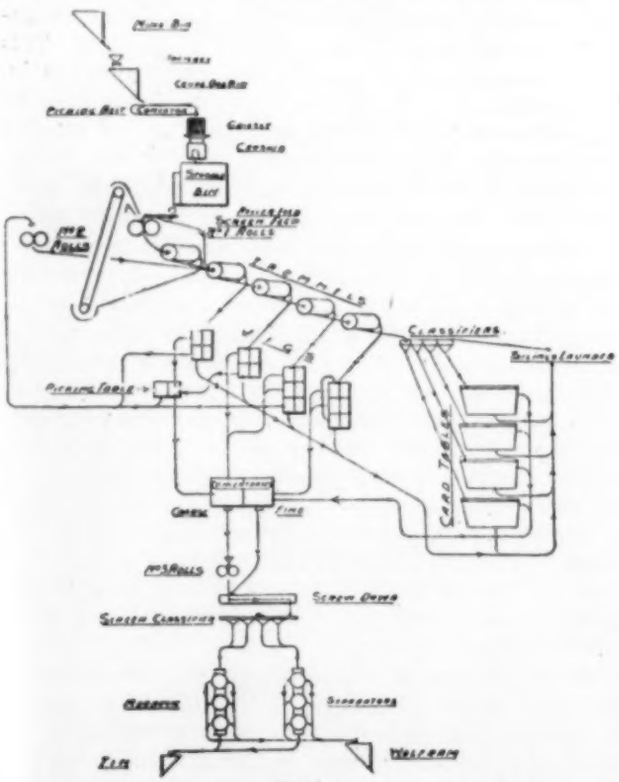


FIG. 1.

consists of a series of sieves, the coarsest having six holes per inch; while oversize is returned to the rolls. Each magnetic machine has three poles and three discs and a 15-in. feed belt. The feed is delivered by means of glass funnels, discharging on an inclined smooth convex plate which spreads the material in a thin even layer on the belt, of a thickness about equal to the size of the particles being fed.

At Butler's Tin Mine, as shown in the flow sheet in Fig. 2, three methods of concentration are in use. Wet concentration practiced in the primary plant recovers 80 per cent of the tin contained in the ore, and about 67 per cent of the tungsten and lead. The concentrate analyzes to Sn 53, WO_3 12, and Pb 5 per cent, which is too high in lead for disposal. The latter is almost

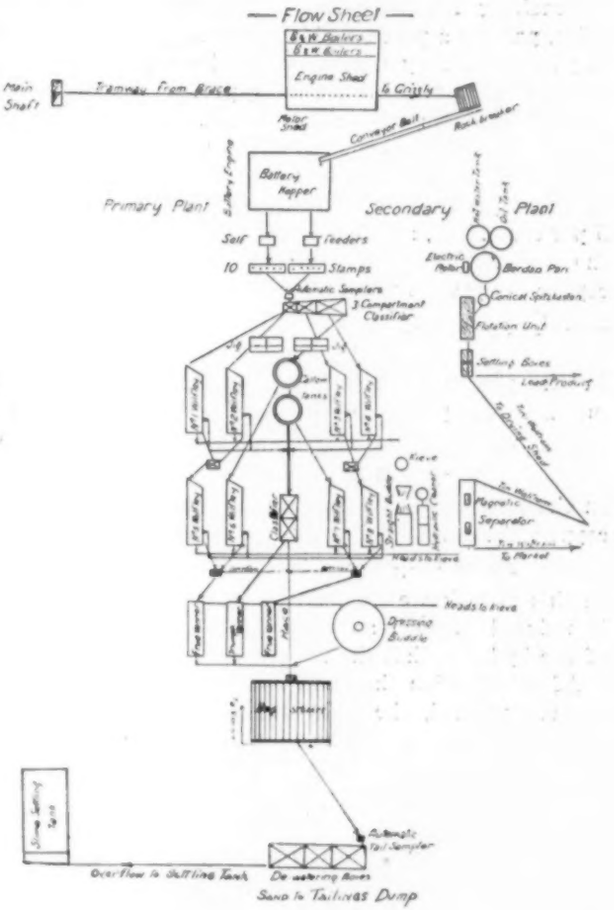


FIG. 2.

completely recovered in a M. S. flotation unit, and the tin and tungsten separated magnetically after drying. The overall recovery is considered good in view of the excessive amount of slimes produced.

Influences of Positive and Negative Ions on Concrete—Mr. J. C. Witt in the *Philippine Journal of Science*, 1918, 13A., p. 28-29, gives an account of the influence of several salts on the setting of cement. Comparative conditions were not arranged so that general deductions can not be drawn. Experiments were made with four cements and eleven salts under similar conditions—chlorides (Na, Zn, Cu), nitrates (Na, K, NH_4), sulphates (Na, Zn, Cu) and bicarbonates (Na, K). The effect was generally to lower the tensile strength, and any increase, which was usually associated with sulphate, was very small. The cement with the highest content of calcium seemed to be affected the most. The sulphates and chlorides of zinc and copper caused a retardation in the initial set, which increased with the concentration. The other salts caused a varying retardation which reached a maximum and then diminished. The positive ion seems to have the greater influence, which would naturally be expected, inasmuch as it would effect the ionized calcium.

Recent Chemical and Metallurgical Patents

Leaching Process.—EVALD ANDERSON, of Los Angeles, patents a process of leaching copper ores containing carbonates by means of an electrolyte containing ferrous salts, which effectually prevent the precipitation of insoluble copper compounds. As a specific instance he agitates one ton of 0.5 per cent copper ore containing some limestone with two tons of leach containing 1 per cent Cu as $CuCl_2$, 0.5 per cent Fe as $FeCl_2$, 5 per cent NaCl, and 5 per cent $CaCl_2$. The $CuCl_2$ takes the copper into solution as CuCl. Ordinarily, insoluble copper compounds would be formed as follows:

$$2CuCl_2 + 2CaCO_3 + H_2O = CuCO_3 + Cu(OH)_2 + 2CaCl_2 + CO_2$$

In the presence of ferrous chloride, however, these insolubles are partly dissolved and partly reduced, thus:

$$3CuCO_3 + 3Cu(OH)_2 + 4FeCl_2 + 3H_2O = 4Fe(OH)_3 + 2CuCl_2 + 4CuCl + 3CO_2$$

In the last reaction, ferrous iron is oxidized by cupric copper, the reverse of the usual reaction:

$$Fe^{+++} + Cu^{+} = Fe^{++} + Cu^{++}$$

In this case, however, the concentration of ferric ions is reduced to such an extent, due to the insolubility of the hydrate, that the usual reaction is reversed.

After agitation the leach solution is withdrawn and the ore washed, the combined leach and wash water

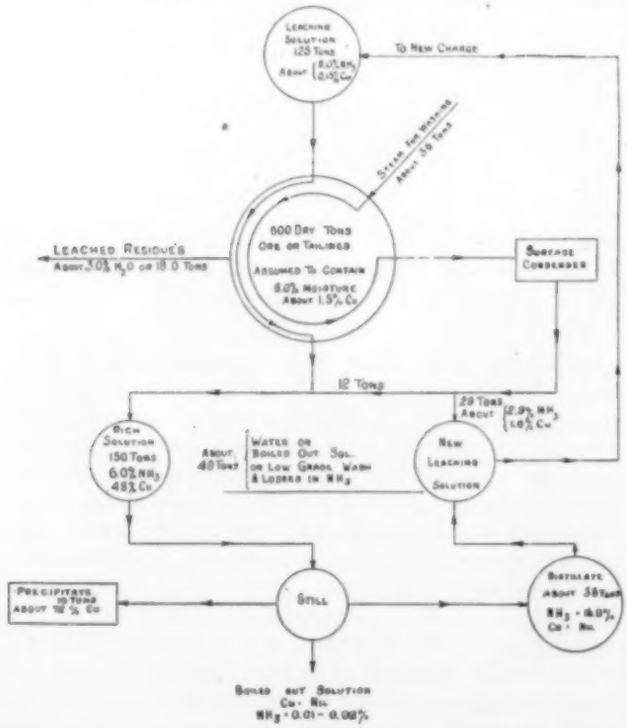


FIG. 1.

equalling two tons as at the first, but carrying 1.24 per cent Cu, partly cuprous and partly cupric. Of this, 0.386 tons are passed over scrap iron to recover cement copper, and an equivalent amount of iron is dissolved as $FeCl_2$. The barren solution is reunited to the pregnant leach, 8.5 pounds of chlorine added by passing through an electrolytic chlorine cell, when the ferrous chloride is oxidized to ferric chloride, and the latter oxidizes cuprous chloride to cupric chloride. Sufficient NaCl is added to bring the sum of NaCl and $CaCl_2$ up to 10 per cent, when the original leach is reconstituted. The total iron in the solution is kept balanced by selection or concentration of the ore, or by oxidizing and precipitating an excess with carbonates present in the ore. A deficiency would be made up by adding suitable salts. Precipitation of dissolved copper may be effected in the electrolytic tank, when the deficit of iron would be made up as above. (1,263,727; assigned to International Precipitation Co., Apr. 23, 1918.)

Cerium Fluorides.—In the method of preparing non-hygroscopic cerium and other rare earth fluorides from the sulphuric acid extraction of monazite sands in connection with the manufacture of thorium compounds for Welsbach mantles, MR. DEAN BURNS of Lakewood, Ohio (assignee, National Carbon Co., Cleveland, Ohio), has patented the process of washing the occluded sulphates from the fluoride precipitate with a solution of sodium fluoride in accordance with the following equation:

$$MSO_4 + 2NaF = Na_2SO_4 + MF_2$$

where M represents the occluded rare earth metal. This reaction takes place slowly at ordinary temperatures, but upon calcination runs to completion. This treatment produces an almost 100 per cent pure precipitate, whereas without the washing 20 per cent of occluded sulphates would be present, making the product very hygroscopic and unfit for use in the manufacture of arc lamp electrodes. (1,272,375, July 16, 1918.)

Pyridine from Ammonium Sulphate Mother Liquor.—Messrs. FRANK E. DODGE of New York and FREDERICK H. RHODES of Philadelphia patent the process of recovering the pyridine bases from the bath liquor of the direct or semi-direct ammonium sulphate process by the neutralization of the bath liquor with ammonia, etc., and consequent decomposition of the pyridine sulphates, and the subsequent recovery of the freed water insoluble pyridine bases from such neutralized baths by agitating the solution with a pyridine oil solvent, which is readily separated and the pure pyridine bases distilled therefrom. The purified alkaline ammonium sulphate is returned to the extraction bath and may be used to wash the crystalized salts en route. (1,274,998-1,275,000; Aug. 6, 1918.)

Pyroxyline Composition of Exceptional Durability.—Camphor-collodion compounds of the ordinary type are usually more or less brittle. Mr. PEPPINO MAJORANA of Louisville, Kentucky, finds that alcohol used in compounding the ingredients gives specially desirable products. He patents a composition within the limits:

	Per Cent
Clear collodion	75. — 85.
Spirits of camphor	5.5— 7.5
Gum camphor	8 — 10.5
Dye	2. — 3.

In the manufacture of phonographic ribbons having sound wave lines pressed into both sides, it is claimed that there is no liability of the material to tear or break, even at these areas of minimum thickness. (1,275,063; Aug. 6, 1918.)

Starting Sheet Suspension.—HENRY S. MONTGOMERY and HENRY A. TOBELMANN, of Ajo, Ariz., have found that an electrolytic starting sheet, if hung between the ends of a loop, riveted thereto, will not build up at the edge betwen the loop ends, but on the contrary, the sheet is dissolved at such a rate that it falls from its support into the tank before any considerable metal has been deposited. In order that the loops and sheet may remain connected it has been found that the connection

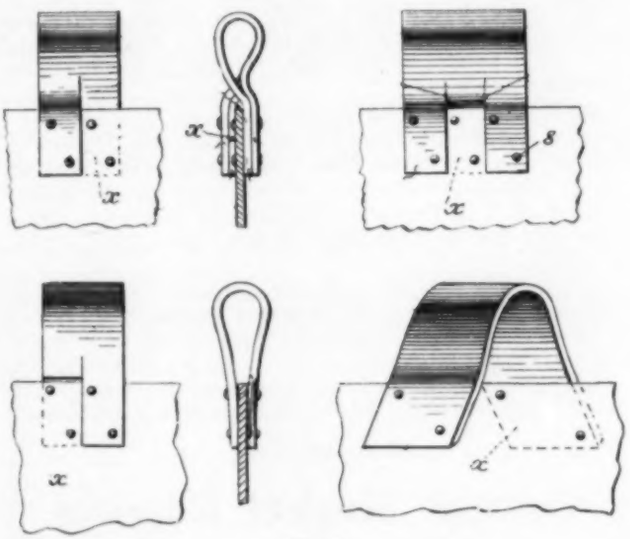


FIG. 3

should be made in such a way that there shall be no metal of the sheet between the layers formed by the loop legs; that is, so that a free surface of starting sheet shall always be opposite the area covered by the supporting loop. The various methods of making this connection are illustrated in Fig. 3 and need no description. (1,269,458; June 11, 1918.)

Ammonia Leaching.—EARL T. STANNARD, of Kennecott, Alaska, patents a method whereby volatile solvents can be used in the leaching of ores, and extracted in such a manner that large losses in leached residues are avoided. Fig. 1 shows a typical instance of his process as applied to one lot of 600 tons of 1.5 per cent copper ore. He uses a closed leaching tank capable of being sealed and operated under pressure, with a steam inlet at the top and the usual filtering bottom. Approximately 1.1 pounds of ammonia are needed per pound of copper in the charge; in the illustration 125 tons of 8 per cent solution is indicated. The amount of solution varies with the fineness of the ore; a minimum amount being naturally desirable in order to reduce the total mass of liquids to be handled in process. After the rich solution has been drained from the ore, washing is done by introducing steam under pressure from above. This steam penetrates into the bed slowly, being condensed as it reaches cold ore, when the condensate trickles on down, effectually washing before it the entrapped rich liquor. In this manner the copper salts in solution are kept ahead of the heated areas, thus obviating the danger of formation of insoluble copper compounds in the leach tank. When the total volume of ore has become permeated by live steam, the condensate ceases to flow—it having previously been added to the original filtrate—and the steam and ammonia it contains is then diverted to the surface condenser, where both are liquefied and returned to the new leaching solution. The amount of steam varies as the temperature of the ore, its nature and sizing, the depth of bed and the extraction of the solvent required; in the illustration, the steam is interrupted when the leached residues contain 0.05 pounds of ammonia per ton. This economical point of wastage varies with the relative cost of ammonia and steam. The leached residues are hot and contain but little moisture which readily evaporates when the tank is opened, giving a dry material which is easily handled. The rich solutions are boiled in a still, black oxide of copper being precipitated, ammonia being volatilized and condensed in suitable apparatus, and the boiled-out solution used to the required extent in making up fresh leaching solutions. (1,238,954; assigned to Kennecott Copper Corporation, Sept. 4, 1917.)

Phosphorus from Molten Slag.—The electric furnace smelting of a mixture of phosphates, sand and coke, with the accompanying reduction and distillation of phosphorus and its collection under water, has been in successful use for a decade. Mr. H. O. H. WENMAN of Bishop's Castle, England, patents passing molten slag direct from the iron furnace with sufficient silica and coke added, through an electric furnace, thereby accomplishing the old process with a saving in electric consumption of about 90 per cent. The reaction takes place at from 1300 to 1500 deg. C.

$$Ca_3(PO_4)_2 + 3SiO_2 + 5C = 2P + 5CO + 3CaSiO_3.$$

(1,274,479; Aug. 6, 1918.)

Anode Suspension.—JULIUS H. GILLIS, of Toronto, Ontario, notes the disadvantages of suspending anodes by upward projecting lugs. These remain as scrap for remelting, accidental breakage is common and they are difficult to cast. Lead suspensions are not desirable owing to the low tensile strength of the metal. Lead-covered suspension materially thicker than the anode cause growth of cathode crystals opposite any projecting portion, rapidly short circuiting the cell. The inventor discovered that anode connectors of aluminium, somewhat of the shape shown in Fig. 4, overcome most of these difficulties, in that aluminium rapidly forms a continuous deposit of non-conducting salts when immersed in ordinary electrolytes. He casts a small block of copper 9 into the hanger so as to give a good metallic contact between hanger and cathode. (1,267,653; assigned to British America Nickel Corporation, Ltd.)

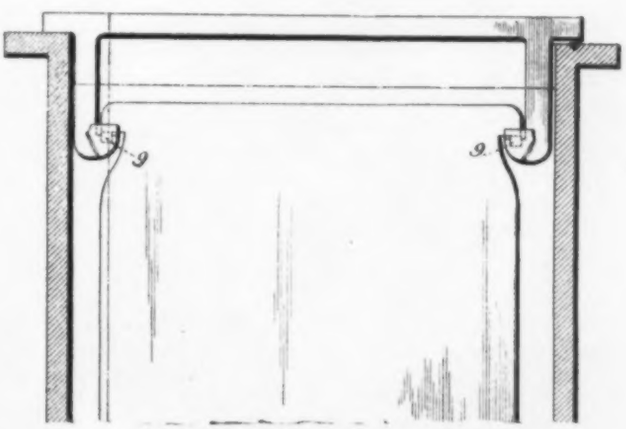


FIG. 4

Personal

MR. H. W. ALDRICH has resigned his position with the Anaconda Copper Mining Company to become assistant general superintendent of the Inspiration Consolidated Copper Company's plant at Miami, Ariz.

DR. SERGIO BAGNARA, metallurgist of the St. Joseph Lead Co. of Bonne Terre, Mo., has been appointed metallurgical engineer of the Ordnance Department. Dr. Bagnara is on his way to Washington, D. C., but expects to see service in France.

MR. HARRY B. CHAPMAN, formerly manager of the Chapman Engineering Co., Texas City, Texas, is now connected with the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

MR. CHARLES Y. CLAYTON is now with the Bureau of Mines, Pittsburgh, Pa.

MR. E. P. DILLON is now general manager of the Research Corporation of New York. He was formerly manager of the power division, New York office, Westinghouse Electric & Manufacturing Co.

MR. C. E. DRAYER has been engaged as national secretary of the American Association of Engineers, Chicago, Ill., by the Board of Directors.

MR. W. C. EBAUGH has left Salt Lake City for Newark, Ohio, where he will become a member of the faculty of Denison University.

MR. J. H. FENTON, of the Los Angeles office of the Westinghouse Electric & Mfg. Company, has recently been appointed manager of the industrial division of that office, which includes jurisdiction over the Tucson and El Paso offices.

MR. H. M. FREEBURN has resigned as assistant engineer of the Pennsylvania State Department of Health to become associated with the engineering staff of Wallace & Tiernan Company, Inc., New York City, manufacturers of chlorine control apparatus and sanitary engineering specialties. Following his graduation from the Sanitary Engineering course of the Pennsylvania State College, Mr. Freeburn was an instructor at the institution and was in charge of experimental sewage work.

MR. R. R. HENDERSON, formerly chief chemist of the Vreeland Chemical Co., has resigned his position with that firm in order to devote his entire time to consulting practice. He now has his headquarters at Little Falls, N. J.

MR. ROBERT M. KEENEY has resigned as manager of The Ferro Alloy Co., Denver, Colo., to become general manager of The Iron Mountain Alloy Co., Denver, Colo.

MR. WILLIAM KOROTKIN has accepted a position in the engineering department of the Burro Mountain Branch of the Phelps-Dodge Corporation, Tyrone, New Mexico.

MR. J. N. MAHONEY, for 12 years a member of the engineering department, has tendered his resignation from the Westinghouse Electric & Mfg. Company, to open consulting offices in New York.

MR. B. MAGNUS has been commissioned captain in the Engineers Reserve Corps, and is now on active duty. He requests that all communications for him be sent care of Henry M. Toch, 320 Fifth Ave., New York City.

MR. JOHN C. MERRILL is the successor to the firm of Sulliger and Merrill, located at 1400 Hibernian Building, Los Angeles, California.

MR. MERLE G. PETERSON is now connected with the Walter A. Zelnicker Supply Co.'s Chicago sales force at 428 First National Bank Building.

PROFESSOR J. H. RANSOM has been elected professor of chemistry and director of the chemical laboratories of Vanderbilt University at Nashville, Tenn. This university is considered to be the standard for college education in the South and the chemistry department is among the strongest in the university. Professor Ransom brings to his new duties a wide and successful experience which must prove of advantage to the university and to the scientific education of the South. For a number of years Professor Ransom has been professor of general chemistry in Purdue University, and offered his resignation there just before the close of the school year just ended.

MR. H. J. SEAMAN of Catasauqua, Pa., formerly general manager of the Atlas Portland Cement Co., Northampton, Pa., has been appointed manager of the German-American Portland Cement Co., La Salle, Ill., by A. Mitchell Palmer, Alien Property Custodian.

MR. HENRY STROH has recently been added to the sales force of the Walter A. Zelnicker Supply Co., St. Louis, Mo. Prior to this he was connected with the Elliot Frog and Switch Company.

MR. T. AN. TESCH established on May 1, 1918, an engineering and construction office at Tumba, near Stockholm, Sweden. He will devote himself especially to the construction of modern iron and steel works, electric or non-electric.

MR. C. E. VAN BARNEVELD is in Denver, where he will remain for a time in connection with war-metal for the Bureau of Mines.

MR. CLAUDE C. VAN NUYS has resigned his position as professor of physics in the Colorado School of Mines and has removed to New York City, where he will be physicist for the Air Reduction Co.

MR. C. H. VOMBAUR is now vice-president of the T. W. Price Engineering Co., Woolworth Bldg., New York City.

Current Market Reports

Non-Ferrous Metal Market

Monday, August 26.—Many metals go from producer to consumer via other channels than the open market, so that available supplies are in effect assigned with prices economically fixed and not fluctuating with the demand.

Aluminium:—The Government prices on ingots of 90 to 99 per cent Al are $660 a ton f.o.b. plant in 50-ton lots, $662 down to 15-ton lots and $664 down to 1 ton, which prices will be effective for the remainder of this year. Prices per pound for small lots vary from 40 to 45c.; sheet aluminium, 18 ga. and heavier, 42c.; powdered aluminium, $0.65 to $3.00, according to mesh.

Antimony:—Increase of production costs in the Chinese mines due to present war activities in Asiatic Russia has resulted in a stronger buying demand and limited offerings. The price, duty paid, is now firm at 14⅜ to 14⅝c.

Chrome:—High-grade material is bringing a premium, 50 per cent ore selling at $1.70 per unit.

Copper: The price of $520 per ton has been continued by the War Industries Board for car load lots and 27.3c. per pound for smaller quantities. It is considered better to curtail nonessential consumption to obtain the Governmental requirements than to allow a sufficient price to make lean mines profitable.

Copper sheets, hot rolled, lb	$0.36 — $0.37
Copper sheets, cold rolled	.37 — .38
Copper bottoms	.44 — .45
Copper rods	.36 — .37
Copper wire	.29 —
High brass wire	.28 — .29
High brass sheets	.28 — .29
High brass rods	.26 — .28
Low brass wire	.32 — .34
Low brass sheets	.32 — .34
Low brass rods	.33 — .35
Brazed brass tubing	.37 — .39
Brazed bronze tubing	.42 — .44
Seamless copper tubing	.41 — .43
Seamless bronze tubing	.45 — .46
Seamless brass tubing	.37 — .39
Bronze (gold) powder	1.00 — 1.75

Lead:—The lead market is limited by selling restrictions. Producers must sell at a uniform and pre-arranged price. In car load lots at East St. Louis, the price is $155 per ton. In New York, jobbers sell in jobbing lots at 8.55c. per pound plus cartage, though the wholesale price is still fixed at 8.05c. Full sheet lead, 10c.; cut sheets, 10¼c.

Manganese:—Prices remain at $1.35 per unit basis for better grades.

Molybdenum:—The price is $1.00 per unit for 90 per cent MoS_2.

Zinc: Spelter is advancing. East St. Louis selling at from $178, to $182, per ton in car load lots. New York prices range between 9⅜ and 9¾c. per pound; sheet zinc, 15c. and zinc dust, 16c. to 20c. per pound in 1600-lb. casts.

Tin:—Tin prices are declining, there being no large buyers on the open market and few dealers selling. Straits tin for September and October shipment from Singapore are offered at 79c. per pound subject to permit for consumption. About 3000 tons arrived during the first half of August. Tin for export from England has been quoted at 83c. and Banca at 84c. Spot tin is 88c. Babbitt metal varies between $1.10 and 70c.; solder (50-50), 73c. per pound.

Tungsten:—High grade Wolframite and Scheelite with no tin, no copper and low manganese and over 70 per cent WO_3 is quoted at $24 per unit.

Silver:—The Government has set a price of $1.01⅛ per troy ounce. This advance is due to the great amount of silver necessary to send to India to settle the European trade debit of $360,000,000. As the world production of silver is only 172,000,000 ounces annually, Great Britain and the United States have been drawing on their silver currency. The Federal Reserve bank notes, our ninth form of monetary exchange, is now being introduced to release this great silver disbursement. Our army in Europe is now being paid in silver also.

OTHER METALS

Bismuth, lb	$3 50—	$3 65
Cadmium	1 50—	....
Cobalt	2 50—	3 50
Magnesium	1 75—	2 00
Mercury, 75 lb	175 00—	....
Mercury, lb	1 95—	....
Nickel, ingot, shot, electrolytic	.40—	.45
Iridium, oz	175 00—	....
Palladium, oz	135 00—	....
Platinum, oz	105 00—	....

The Iron and Steel Market

No important new regulations have been promulgated since last report for the distribution of pig iron and steel products. The system is regarded as practically perfect, and seems to be entirely satisfactory both to the War Industries Board and to the producers. What is unsatisfactory to both, and also to many buyers, including both jobbers and manufacturing consumers, is that the supplies are not sufficient to stretch to the less essential consumptive purposes, let alone to those which are not recognized as entitled to any preference at all.

The whole thing, however, is a matter of viewpoint. In the last analysis it is eminently proper that the conditions viewed in various details should appear unsatisfactory. We are engaged in a great war. The soldier in the front line trench is quite dissatisfied. He should be in what is the enemy's front line trench, but if he were there the enemy's second line would be his objective.

There are set prices for iron and steel products, no competition. Competition is dead. There is the fiercest competition in the United States that has ever been experienced. It is of a different order. The American Navy is what it is to-day because it has always been the field of sharp competition, between men, gun crews, ships and fleets. There is competition between shell factories and forge shops, between forge shops and mills producing shell steel. Shipways launching hulls are competing with engine and boiler makers on the one hand and with steel mills supplying steel on the other. Each branch of each war activity is striving to move faster than others. The way to win the war is to take the view that shipbuilding is behind steel making, or steel making behind shipbuilding, not that the one is ahead of the other. Everything is in the wrong place that is not in the vanguard.

If the consumers whose activities are not particularly helpful in winning the war were receiving a full supply of steel, something would be altogether wrong. The war activities should be able to consume that steel. It is precisely right that steel should be "scarce" from the viewpoint of the buyer who is accorded little or no preference by the regulations. That is the view taken even by those who experience the deprivation.

All things considered, the rate of steel production is very satisfactory by comparison with the conditions under which steel is produced. In June a rate of ingot production of 43,500,000 gross tons a year was attained. In July, with hot weather, the rate declined to about 42,250,000 tons, which is a smaller decline than usually occurs at this season of the year. August has perhaps developed a slightly lower rate, but better rates than 43,500,000 tons are expected later in the year. With the supply of scrap scant and the quality quite indifferent, with labor far from plentiful, and with multitudinous difficulties confronting furnaces and mills, the rate of production is on the whole very good. The existing ingot producing capacity is probably ratable at more than 47,000,000 tons a year with all conditions favorable but with conditions as they obtain, the lower rate is gratifying.

Demands for pig iron and steel to be shipped abroad, either for direct use by the A. E. F., or for repayment of material borrowed by General Pershing, or for new demands of our Allies, continue to increase. Additional car orders have been placed, together with orders for 200,000 tons of rails. Shell orders have been increasing, shipbuilding is speeding up week by week and new military wants are constantly developing.

The present trend is in the direction of further curtailment in the production of finished steel not directly involved in war work. Sheet mills, which have been operating at barely 60 per cent capacity, may be furnished somewhat less steel in future. The steel allotted to rod mills has decreased somewhat. Standard steel pipe manufacture has been on a somewhat reduced scale and the August distribution to jobbers is less than was expected. Merchant mills are allotted little more steel than enough to fill the higher priority orders, evidenced by the fact that the B-4 priority accorded to jobbers is not sufficient to give them much merchant bar tonnage.

Scarcely any class D steel is developing. The rule is one thing and operations under it are quite another thing. According to the regulations, if a manufacturer has material or manufacturing facilities beyond what is necessary to take care of priority orders and requirements of the preference list, the surplus becomes class D. The manufacturing facilities may be used and the material shipped in connection with a use not accorded preference, provided the manufacturer has the "permit" of the Director of Steel Supply "first had and obtained." The application must be made by the prospective producer, not by the prospective buyer. Apparently there is no harm in applying for permission to do something. One may then avail himself of the permission or not, as circumstances dictate. That is not the view of many steel producers, however, who reason that to apply for a permit to make and ship class D steel represents an admission that the thing can be done, and if it can be done, the War Industries Board may very properly hold the producer to the admission and require that the thing be done, that the steel be shipped for some war use, excuses not accepted. In other words, one may apply for a permit to ship 500 tons of class D steel and receive by return mail a priority order to ship 500 tons. Few permits are applied for and still fewer are granted. Some mills have slight surpluses of odds and ends but will probably use the material as scrap, to swell the production of war steel, rather than flirt with the permit system.

Abuses of Scrap Regulations

The very serious abuse of the scrap regulations as regards the purchase and scale of so-called "unguaranteed low phosphorus scrap" at $34 when the price should be $29 has been taken in hand in vigorous fashion by the authorities. The scrap committee of the American Iron and Steel Institute has issued a circular letter to all steel makers promising drastic action if the practice is not stopped and stating that existing contracts violating the provisions

should be canceled. The American Board of Scrap Iron Dealers has likewise issued a circular to its own members.

Low phosphorus scrap is No. 2 in the regulations, and three subdivisions are named, "C" being stated to cover "steel knuckles and couplers, rolled steel wheels, railway steel springs, carbon tool steel and material similar in quality and character." For this material $34 may be paid for use in acid open-hearth furnaces. For ordinary heavy melting steel no more than $29 may be paid.

The regulations were clearly worded and could not possibly be misunderstood by anyone of average intelligence. A trade had arisen, however, in what was called "unguaranteed low phosphorous scrap," the term being a pure fiction, and material that would hardly grade as heavy melting steel was being bought and sold at the $34 price, much of it evidently intended for use in basic open-hearth furnaces. These evasions have not been altogether denied by the trade, but the argument has been used that the payment of the premium does not hurt the Government, as its purchases of finished steel products are at set limits. The argument overlooks the important fact that the payment of the premium reduces the profit of the mill, and as the Government is likely to tax the last $5 of profits 80 per cent, there is ground for arguing that the payment of $5 extra causes the mill to lose $1 and the Government $4.

Chemical Market

HEAVY CHEMICALS:—The markets in general have been extraordinarily quiet, during the last few days in particular. Caustic and soda ash, which may be called the barometers of the trade, have been very inactive with a slight falling off in saccharine. As to dealers' profits in sulphuric, definite statement has been made by the authorities.

Sulphur:—The chemically pure floured product is subject to a very wide demand which, it is said, has increased 50 per cent over the normal, in view of which and remembering that the supply has been somewhat curtailed temporarily, some of the interests in the trade believe that this material will shortly see necessarily increased prices. Shipments are said to be coming in more slowly, confirming statements with regard to shortening of stocks. Nevertheless there has been no advance in prices during the week, as quotations continue on the basis of from $4.35 to $4.50 per hundred pounds f.o.b. New York.

Sulphur Chloride:—Orders for single jugs of this material are being quoted prices as high as 20c. per pound while in larger quantities from 15 to 19 and 20c. is asked. For the material in drums from 7½ to 9c. is the range of asking prices, depending upon the quantity and the buyer. Drums are extra and prices quoted f.o.b. New York.

Epsom Salts:—There is a good demand for this product but business lately has been of a very quiet character. Certain large producers have been compelled to withdraw from the market for the present owing to depletion of reserve stocks, but prices asked in other directions continue at from 3.40 to 3.50 f.o.b. New York with prices at the works holding 3c. in bags and 3¼c. in barrels for the U.S.P. material.

Bleaching Powder:—It has become practically impossible to locate spot holdings as even directions ordinarily in close touch with sources are themselves unable to accept orders for earlier than September shipment. The last sale reported was for shipment of material in from two to three weeks at 4½c. f.a.s.

Permanganate of Potash:—The market is very quiet with manufacturers continuing to quote 1.75 for the U.S.P. and from 1.30 to 1.50 for certain high-grade technical goods, although there are rumors of purchases at much below these figures.

Bichromate of Soda:—This market has seen a slight weakening although large factors state that sales have been consummated right along at 26c. Offerings of 24¾c. f.o.b. works have been made and contracts have been signed at 23½c. Authorities, however, feel that the market will see a stiffening in a few days. Producers of soda from the domestic chrome ore are asking 24¼c. The Caledonian chrome is not being imported directly but small quantities are coming in from time to time on vessels which use it for ballast on their return voyages; such quantities are small ton lots, however.

Calcium Carbide:—This market continues to hold at 19c. for September shipment, as spot lots are scarce. Exportations are limited by the lack of bottoms.

Sodium Sulphide:—Holdings are hard to find and inquiry is strong. Cars of spot material have changed hands at 8c. but offerings are now on the basis of 8½c.

Carbon Bisulphide:—Demand is steady with sales being made through the usual channels direct to consumers in most cases. Stocks are said to be sufficient to meet the requirements and prices therefor remain firm at 8c. per pound f.o.b. works.

Caustic Soda:—Transactions have been very few with the large inquiry on material rolling toward the Pacific coast on which prices are quoted 4.30 western works. Ex warehouse New York is quoted at 4.15.

COAL TAR PRODUCTS:—Very little change has taken place in these items as these markets have also been unusually quiet; saccharine perhaps showing the greatest activity with a slight falling off both in demand and price during the last few days.

Phenol:—Various prices are heard and some uncertainty in the trade as to just what the market may be in view of quotations from important directions at from 44 to 46c. and the knowledge that 43 or better may still be done. This latter price is quoted by directions having contracted some time ago and the higher prices quoted above apply to present business. Reports of scarcity are current with the result that prices are rather firm. It is not known that any new export licenses have been granted, the material going forward from time to time being upon licenses which had been revoked and later renewed.

Benzol:—Conditions remain the same with regard to offerings in tank car quantities at 23c. with certain directions willing to do business on the basis of 22c. on contract. For material in drums the level of 28c. continues to hold; but in view of the placing of large Government orders there is a general feeling that prices will see an appreciable advance in the Fall owing to a resulting shortage of stocks.

Saccharine:—A slight falling off is noted in the prices prevailing at this writing, attributed by some to the rumor that the British Government is to cancel all licenses and prohibit further importations of this product beginning Sept. 15, and another rumor which was heard to the effect that the government contemplated taking over the manufactories. Largest factors in the manufacture state, however, that they have no knowledge of such intention on the part of the authorities. Soluble material is holding at the level of the last sales reported, 35.50, with insoluble available at 33.00. Very few sales are reported.

Paraphenylenediamine:—The demand for this material is fair with the prices showing a slight advance over those last reported, as from 4.00 to 4.50 is now asked depending upon grade and quantity. It is said that new manufacturers are about to enter the field and to produce a material of 99½ per cent. The C.P. product is almost unobtainable.

Dimethylaniline:—This market is not active and prices show no change. Supplies are said to be rather plentiful with quotations continuing to be made at 73c. spot, drums extra and nonreturnable.

Dinitrophenol:—There is very little of the material to be obtained as the factors in its production are directing their output to Government ends and have none but a very small quantity which may be offered in the open market at from 51 to 52c.

Aniline Oil:—Supplies are said to be getting more scarce with the natural result of a firmness noted in the market. From 28½ to 29c. for small lots is asked but on contract 28c. can still be done. In some directions 30 and 32c. are heard for large and small drums respectively.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, AUG. 26 1918

Acetic anhydride	lb.	1.60 —	1.85
Acetone	lb.	.25½ —	.25¾
Acid, acetic, 28 per cent	cwt.	5.96 —	6.11
Acetic, 56 per cent	cwt.	10.76 —	10.87
Acetic, glacial, 99½ per cent, carboys	cwt.	19.00 —	19.20
Boric, crystals	lb.	.13½ —	.15
Citric, crystals	lb.	.82 —	....
Hydrochloric, C. P	lb.	Nominal	
Hydrofluoric, 30 per cent in barrels	lb.	.06 —	.06½
Lactic, 44 per cent	lb.	.15 —	.16
Lactic, 22 per cent	lb.	.06 —	.07
Molybdic, C. P	lb.	6.90 —	7.40
Nitric, 36 deg	lb.	Nominal	
Nitric, 42 deg	lb.	.08½ —	.10
Oxalic, crystals	lb.	.42 —	.44
Phosphoric, 47-50 per cent paste	lb.	.08 —	.10
Phosphoric, ref. 50 per cent	lb.	.35 —	.40
Picric	lb.	.75 —	.85
Pyrogallic, resublimed	lb.	3.25 —	3.50
Sulphuric, 60 deg	ton	18.00 —	....
Sulphuric, 66 deg	ton	28.00 —	....
Sulphuric, oleum (Fuming), tank cars	ton	60.00 —	65.00
Tannic, U. S. P., bulk	lb.	1.40 —	1.50
Tartaric, crystals	lb.	.82 —	.83
Tungstic, per lb. of W	lb.	1.70 —	1.75
Alcohol, sugar cane, 188 proof	gal.	4.91 —	....
Alcohol, wood, 95 per cent	gal.	.91½ —	.92
Alcohol, denatured, 180 proof	gal.	.68 —	.69
Alum, ammonia lump	lb.	.05½ —	.05½
Alum, chrome ammonium	lb.	.18 —	.19
Alum, chrome potassium	lb.	.20 —	.21
Alum, chrome sodium	lb.	.12½ —	.13
Alum, potash lump	lb.	.09½ —	.10
Aluminium sulphate, technical	lb.	.02 —	.02½
Aluminium sulphate, iron free	lb.	.03½ —	.04
Ammonia aqua, 26 deg., carboys	lb.	.12 —	.16
Ammonia, anhydrous	lb.	Nominal	
Ammonium carbonate	lb.	.13 —	.14
Ammonium nitrate	lb.	(Fixed Price)	.15
Ammonium, sulphate domestic	lb.	.07½ —	.08
Amyl acetate	gal.	5.30 —	5.35
Arsenic, white	lb.	.09½ —	.17
Arsenic, red	lb.	.65 —	.70
Barium carbonate, 99 per cent	ton	80.00 —	90.00
Barium carbonate, 97-98 per cent	ton	65.00 —	67.00
Barium chloride	ton	65.00 —	70.00
Barium sulphate (Blanc Fixe, Dry)	lb.	.04½ —	.05
Barium nitrate	lb.	.12 —	.14
Barium peroxide, basis 70 per cent	lb.	.30 —	.32
Bleaching powder, 35 per cent chlorine	lb.	.02½ —	.03½
Borax, crystals, sacks	lb.	.07½ —	.10½
Brimstone, crude	ton	65.00 —	70.00
Bromine, technical	lb.	.75 —	....
Calcium, acetate, crude	lb.	.04 —	.05
Calcium, carbide	lb.	.15½ —	.16
Calcium chloride, 70-75 per cent, fused, lump	ton	22.00 —	24.00
Calcium peroxide	lb.	1.50 —	1.70
Calcium phosphate	lb.	.22 —	.23
Calcium sulphate 98-99 per cent	lb.	.09 —	.09½
Carbon bisulphide	lb.	.08 —	.09
Carbon tetrachloride, drums	lb.	.14½ —	.33
Carbonyl chloride (phosgene)	lb.	1.10 —	1.50
Caustic potash, 88-92 per cent	lb.	.63 —	.77½
Caustic soda, 76 per cent	100 lb.	4.00 —	4.15
Chlorine, liquid (Government Purchase)	lb.	(Fixed Price)	.07½
Cobalt oxide	lb.	1.60 —	1.65
Copperas	lb.	.02 —	.02½
Copper carbonate	lb.	.30 —	.31
Copper cyanide	lb.	.75 —	.78
Copper sulphate, 99 per cent, large crystals	lb.	.09½ —	.09¾
Cream of tartar, crystals	lb.	.73 —	.80
Epsom salt, bags, U.S.P	lb.	3.40 —	3.50
Formaldehyde, 40 per cent	lb.	.16½ —	.17½
Glauber's salt	lb.	.02 —	.03
Glycerine, bulk, C. P	lb.	.62 —	.65
Iodine, resublimed	lb.	4.25 —	4.30
Iron oxide	lb.	.13 —	.15
Lead acetate, white crystals	lb.	.15½ —	.16½
Lead arsenate (Paste)	lb.	.15 —	.18
Lead nitrate	lb.	Nominal	
Litharge, American	lb.	.11½ —	.14
Lithium carbonate	lb.	1.50 —	2.05
Magnesium carbonate, technical	lb.	.14 —	.15
Nickel salt, single	lb.	.14 —	.15
Nickel salt, double	lb.	.12 —	.13
Phosgene, (see Carbonyl chloride)	lb.	1.10 —	1.50
Phosphorus, red	lb.	1.15 —	1.20
Phosphorus, yellow	lb.	1.02 —	1.13
Potassium bichromate	lb.	.45 —	.46
Potassium bromide granular	lb.	1.35 —	1.36
Potassium carbonate calcined, 85-90 per cent	lb.	.35 —	.38
Potassium chlorate, crystals	lb.	.40 —	.41
Potassium cyanide, 98-99 per cent	lb.	.60 —	.70
Potassium iodide	lb.	3.75 —	3.80
Potassium muriate 80-85 p. c. basis of 80 p. c.	ton	300.00 —	350.00
Potassium nitrate	lb.	.27 —	.31
Potassium permanganate U. S. P	lb.	1.30 —	1.75
Potassium prussiate, red	lb.	2.30 —	2.50
Potassium prussiate, yellow	lb.	.95 —	1.00
Potassium sulphate, 90-95 p. c. basis 90 p. c.	ton	Nominal	
Rochelle salts	lb.	.44½ —	.46
Salammoniac, gray gran	lb.	.22 —	.23
Salammoniac, white gran	lb.	.17 —	.20
Sal soda	100 lb.	1.40 —	1.65
Salt cake	ton	35.00 —	40.00
Silver cyanide, based on market price of silver	oz.	.... —	....
Silver nitrate	oz.	.62½ —	.64½
Soda ash, 58 per cent, light, flat (bags)	100 lb.	2.50 —	....
Soda ash, 58 per cent, dense, flat	100 lb.	3.40 —	3.85
Sodium acetate	lb.	.30 —	....
Sodium bicarbonate, domestic	lb.	.01½ —	.02½
Sodium bicarbonate, English	lb.	.... —	....
Sodium bichromate	lb.	.23½ —	.26
Sodium bisulphite, powd	lb.	.06 —	.07
Sodium chlorate	lb.	.25 —	.25½
Sodium cyanide	lb.	.40 —	.42
Sodium fluoride, commercial	lb.	.17 —	.18
Sodium hyposulphite	lb.	2.60 —	3.60
Sodium molybdate, per lb. of Mo	lb.	2.50 —	....
Sodium nitrate, 95 per cent	100 lb.	4.12 —	5.00
Sodium nitrite	lb.	.27 —	.30
Sodium peroxide	lb.	.35 —	.45
Sodium phosphate	lb.	.04 —	.04½
Sodium prussiate, yellow	lb.	.50 —	.52
Sodium silicate, liquid (60 deg.)	lb.	.02½ —	.03½
Sodium sulphide, 30 per cent, crystals	lb.	.04½ —	.04½
Sodium sulphide, 60 per cent, fused	100 lb.	8.50 —	....
Sodium sulphite	lb.	.05½ —	.06
Strontium nitrate	lb.	.25 —	.30
Sulphur chloride, drums	lb.	.07½ —	.09
Sulphur dioxide, liquid, in cylinders	lb.	.15 —	.40
Sulphur, flowers, sublimed	100 lb.	4.35 —	4.50
Sulphur, roll	100 lb.	3.70 —	3.85
Sulphur, crude	ton	65.00 —	70.00
Tin bichloride, 50 deg	lb.	.28 —	.29
Tin oxide	lb.	Nominal	
Zinc carbonate	lb.	.18 —	.20
Zinc chloride	lb.	.15 —	.15½
Zinc cyanide	lb.	Nominal	
Zinc dust, 350 mesh	lb.	.13½ —	.14
Zinc oxide, American process XX	lb.	.13 —	.14
Zinc sulphate	lb.	.04¼ —	.06½

Coal Tar Products (Crude)

Benzol, pure, water white	gal.	.22 —	.28
Benzol, 90 per cent	gal.	.25 —	....
Toluol, in tank cars	gal.	(Fixed Price)	1.50
Toluol, for non-military use, in drums	gal.	(Fixed Price)	1.55
Xylol, pure, water white	gal.	.45 —	.55
Solvent naphtha, water white	gal.	.18 —	.25
Solvent naphtha, crude, heavy	gal.	.12 —	.15
Creosote oil, 25 per cent	gal.	.45 —	.55
Dip oil, 20 per cent	gal.	.30 —	.32
Pitch, various grades	ton	8.00 —	20.00
Carbolic acid, crude, 95-97 per cent	lb.	1.05 —	1.10
Carbolic acid, crude, 50 per cent	lb.	.60 —	.65
Carbolic acid, crude, 25 per cent	lb.	.35 —	.38
Cresol, U. S. P	lb.	.19 —	.20

Intermediates, Etc.

Alpha naphthol, crude	lb.	1.00 —	1.10
Alpha naphthol, refined	lb.	1.50 —	1.60
Alpha naphthylamine	lb.	.60 —	.62
Aniline oil, drums extra	lb.	.28 —	.30
Aniline salts	lb.	.43 —	.45
Anthracene, 80 per cent	lb.	Nominal	
Benzaldehyde (f.f.c.)	lb.	3.60 —	4.00
Benzidine, base	lb.	1.75 —	1.85
Benzidine, sulphate	lb.	1.40 —	1.45
Benzoic acid U. S. P	lb.	2.65 —	2.85
Benzoate of Soda, U. S. P	lb.	2.65 —	2.85
Benzyl chloride	lb.	2.45 —	2.50
Beta naphthol benzoate	lb.	10.00 —	12.00
Beta naphthol, sublimed	lb.	.85 —	.90
Beta naphthylamine, sublimed	lb.	2.65 —	....
Dichlor benzol	lb.	.15 —	.20
Diethylaniline	lb.	4.00 —	4.50
Dinitro benzol	lb.	.36 —	.38
Dinitrochlorbenzol	lb.	.40 —	.45
Dinitronaphthaline	lb.	.55 —	.60
Dinitrotoluol	lb.	.65 —	.75
Dinitrophenol	lb.	.55 —	.60
Dimethylaniline	lb.	.70 —	.78
Diphenylamine	lb.	1.00 —	1.10
H-acid	lb.	3.00 —	3.40
Metaphenylenediamine	lb.	1.85 —	2.05
Monochlorbenzol	lb.	.17 —	.20
Naphthalene, flake	lb.	.09 —	.09½
Naphthalene, balls	lb.	.11 —	.12
Naphthionic acid, crude	lb.	1.20 —	1.30½
Naphthylamin-di sulphonic acid	lb.	1.00 —	1.10
Nitro naphthaline	lb.	.45 —	.50
Nitro toluol	lb.	.55 —	.60
Ortho-amidophenol	lb.	.... —	....
Ortho-dichlor-benzol	lb.	.15 —	.20
Ortho-toluidine	lb.	.95 —	1.10
Ortho-nitro-toluol	lb.	.75 —	.85
Para-amidophenol, base	lb.	4.00 —	4.50
Para-amido-phenol, H. Ch	lb.	4.25 —	5.00
Para-dichlor-benzol	lb.	.15 —	.20
Paranitraniline	lb.	1.70 —	1.85
Para-nitro-toluol	lb.	1.50 —	1.60
Paraphenylenediamine	lb.	3.75 —	4.00
Para toluidine	lb.	2.00 —	2.25
Phthalic acid anhydride	lb.	4.00 —	4.50
Phenol, U. S. P	lb.	.43 —	.46
Resorcin, technical	lb.	5.50 —	7.00
Resorcin, pure	lb.	8.00 —	9.00
Salicylic acid	lb.	.88 —	1.00
Salol	lb.	1.50 —	2.00
Sulphanilic acid, crude	lb.	.32 —	.34
Tolidin	lb.	2.50 —	3.00
Toluidine-mixture	lb.	.85 —	.90

Petroleum Oils

Crude (at the Wells)

Pennsylvania	bbl.	4.00 —	.....
Corning, Ohio	bbl.	2.85 —	.....
Somerset, Ky	bbl.	2.60 —	.....
Wooster, Ohio	bbl.	2.68 —	.....
Indiana	bbl.	2.28 —	.....
Illinois	bbl.	2.42 —	.....
Oklahoma and Kansas	bbl.	2.25 —	.....
Caddo, La., light	bbl.	2.25 —	.....
Corsicana, Tex., light	bbl.	2.25 —	.....
California	bbl.	1.24 —	1.57
Gulf Coast	bbl.	1.80 —	.....
Mexican	bbl.	1.90 —	.....

Fuel Oil

New York	gal.	.15 —	.....
Philadelphia	gal.	.10½ —	.....
Baltimore	gal.	.07½ —	.14½
Pittsburgh	gal.	.07½ —	.10
Texas	bbl.	1.85 —	2.35
Los Angeles	bbl.	1.60 —	.....

Gasoline (Wholesale)

New York	gal.	.24	—	.25
Gas machine	gal.	.41½	—	.....
72-76 degrees	gal.	.33½	—	.39½
70-72 degrees	gal.	.37½	—	.....
67-70 degrees	gal.	.30½	—	.36½
Pittsburgh	gal.	.25	—	.....
Chicago	gal.	.22½	—	.23
Oklahoma	gal.	.22	—	.....
San Francisco	gal.	.20	—	.21

Paraffine Waxes

Crude, 103 to 105 deg. m.pt	lb.	.08½	—	.09
Crude, 118 to 120 deg. m.pt	lb.	.09½	—	.10
Crude, 124 to 126 deg. m.pt	lb.	.10	—	.....
Refined, 120 deg. m.pt	lb.	.13½	—	.....
Refined, 128 deg. m.pt	lb.	.14	—	.....
Refined, 135 deg. m.pt	lb.	.16	—	.16½
Ozokerite, brown	lb.	.75	—	.....
Ozokerite, green	lb.	.85	—	.....

Lubricants

Black, reduced, 29 gravity, 25-30 cold test	gal.	.23	—	.24
Cylinder, light	gal.	.42	—	.43
Cylinder, dark	gal.	.39	—	.41
Paraffine, high viscosity	gal.	.40	—	.41
Paraffine, .903 sp. gr.	gal.	.36	—	.38
Paraffine, .885 sp. gr.	gal.	.26	—	.28

Flotation Oils

(Prices at New York unless otherwise stated)

Pine oil, crude, f. o. b. Florida	gal.	.44	—	.....
Pine oil, steam-distilled, sp. gr. 0.925-0.940	gal.	.58	—	.60
Pine oil, destructively distilled	gal.	.58	—	.60
Pine-tar oil, sp. gr., 1.02 -1.035	gal.	.35	—	.....
Pine-tar oil, double refined, sp. gr. 0.965-0.990	gal.	.42	—	.....
Pine-tar oil, ref., light, sp.gr. 0.950, tank cars, f.o.b. works	gal.	.37	—	.....
Pine-tar oil, ref., heavy, sp.gr. 1.025, tank cars, f.o.b. works	gal.	.28	—	.....
Pine-tar oil, ref., thin, sp. gr. 1.060-1.080	gal.	.32	—	.....
Turpentine, crude, sp. gr. 0.870-0.900	gal.	.45	—	.....
Hardwood oil, f. o. b. Michigan, sp. gr. 0.960-0.990	gal.	.23	—	.....
Hardwood oil, f. o. b. Michigan, sp. gr. 1.06-1.08	gal.	.23	—	.....
Wood creosote, ref. f. o. b. Florida	gal.	.31	—	.....

Naval Stores

Rosin A-E barrel	280 lb.	11.85	—	11.90
Rosin F-I	280 lb.	11.95	—	12.35
Rosin K-N	280 lb.	13.75	—	14.00
Rosin WG-W	280 lb.	14.10	—	14.25
Spirits of turpentine	gal.	.61	—	.62
Wood turpentine, steam distilled	gal.	.63	—	.....
Wood turpentine, destructively distilled	gal.	.56	—	.....
Pitch	bbl. 200 lb.	6.50	—	.....
Tar, kiln dried	280 lb.	12.50	—	.....
Retort tar	280 lb.	13.50	—	.....
Rosin oil, first run	gal.	.63	—	.....
Second run	gal.	.66	—	.....
Third run	gal.	.69	—	.....
Fourth run	gal.	.79	—	.....

Vegetable Oils

Castor oil	lb.	.28½	—	.30
China wood oil	lb.	.30	—	.32
Cocoanut oil	lb.	.17	—	.21
Corn oil	lb.	.18	—	.....
Cottonseed oil, crude	lb.	.20	—	.22
Linseed oil, raw, cars	gal.	1.88	—	1.90
Olive oil	gal.	4.50	—	4.75
Peanut oil, crude	lb.	.18	—	.22
Soya bean oil, Manchuria	lb.	.16	—	.18

Miscellaneous Materials

Barytes, floated, white, foreign	ton	38.00	—	42.00
Barytes, floated, white, domestic	ton	25.00	—	36.00
Beeswax, white, pure	lb.	.36	—	.37
Beeswax, unbleached	lb.	.43	—	.46
Blanc fixe	lb.	.05½	—	.....
Casein	lb.	.17½	—	.28
Ceylon graphite	lb.	.07½	—	.25
Chalk, light, precipitated, English	lb.	.04½	—	.06
China clay, imported, lump	ton	20.00	—	40.00
China clay, domestic, lump	ton	15.00	—	22.50
Feldspar	ton	8.00	—	12.00
Fluorspar, gravel, f. o. b. mines	ton	60.00	—	.....
Fluorspar, washed, powdered	ton	90.00	—	.....
Fuller's earth, powdered	100 lb.	1.50	—	2.00
Japan wax	lb.	.24½	—	.25
Mexican graphite	ton	75.00	—	.....
Madagascar graphite	lb.	.10	—	.15
Orange shellac	lb.	.70	—	.76
Pumice stone	lb.	.04	—	.08
Red lead, dry, carloads	lb.	.10	—	.11½
Soapstone	ton	15.00	—	25.00
Stearic acid, 120 deg. m.pt	lb.	.13½	—	.....
Stearic acid, 140 deg. m.pt	lb.	.19	—	.....
Talc, American, white	ton	20.00	—	40.00
White lead, dry	lb.	.09½	—	.10½

Glues

Extra white	lb.	.36	—	.45
Cabinet	lb.	.31	—	.40
Brown foot stock	lb.	.18	—	.22
Fish glue, 50-gal. barrels	gal.	1.00	—	1.80

Refractories, Etc.

(F. O. B. Works)

Chrome brick	net ton	175.00	—	.....
Chrome cement	net ton	75.00	—	.....
Clay brick, 1st quality fireclay	per 1000	50.00	—	55.00
Clay brick, second quality	per 1000	35.00	—	40.00
Magnesite, raw	ton	30.00	—	35.00
Magnesite, calcined, powdered	ton	50.00	—	65.00
Magnesite, dead burned	net ton	50.00	—	60.00
Magnesia brick, 9x4½x2½	net ton	110.00	—	125.00
Silica brick	per 1000	50.00	—	60.00

Ferroalloys

Ferrocarbontitanium, 15-18 per cent, carloads, f. o. b. Niagara Falls, N. Y.	ton	200.00	—	250.00
Ferrocerium	lb.	15.00	—	30.00
Ferrochromium, per lb. of Cr	lb.	.....	—	.....
Ferromanganese, domestic, 70 per cent basis	ton	250.00	—	.....
Ferromanganese, English	ton	325.00	—	.....
Spiegeleisen (16-18%)	ton	75.00	—	.....
Ferromolybdenum, per lb. of Mo	lb.	4.00	—	4.50
Ferrosilicon, 75 per cent, f. o. b., N. Y.	ton	.....	—	.....
Ferrosilicon, 50 per cent, carloads, del., Pittsburgh	ton	180.00	—	190.00
Ferrosilicon, 50 per cent, contract	ton	160.00	—	170.00
Ferrotungsten, 75-85 per cent, f. o. b., Pittsburgh	lb.	2.35	—	2.40
Ferrouranium, f. o. b. works, per lb. of U	lb.	7.50	—	.....
Ferrovanadium, f. o. b. works	lb.	.....	—	.....

Ores and Semi-finished Products

		Nominal		
Antimony ore, per unit				
Chrome ore, 45 per cent minimum, f.o.b. Cal. per unit	ton	1.50	—	1.55
Chrome ore, 43 per cent and over, New York, per unit	ton	.....	—	.....
Manganese ore, 48 per cent and over, per unit	ton	1.20	—	.....
Manganese ore, chemical	ton	80.00	—	100.00
Molybdenite, per lb. of MoS_2	lb.	1.25	—	.....
Tungsten, Scheelite, per unit of WO_3	ton	24.00	—	.....
Tungsten, Wolframite, per unit of WO_3	ton	24.00	—	.....
Uranium oxide, 96%	lb.	3.25	—	3.60
Vanadium pentoxide, 99%	lb.	10.50	—	.....
Pyrites, foreign	unit	.17	—	.17
Pyrites, domestic	unit	.28	—	.30½

Plant Supplies

BUILDING MATERIALS

Common clay bricks	M	13.00	—	14.00
Hollow tile, 4 x 12 x 12	M	60.00	—	.....
Hollow tile, 12 x 12 x 12	M	170.00	—	.....
Lime	ton	16.50		
Portland cement	bbl.	2.59		
Single glass (82-lb.), 10 x 26–16 x 24		21.00	—	27.00
Double glass (164 lb.), 10 x 26–16 x 29		31.00	—	39.00
Yellow pine lumber	M	39.00	—	45.00
Fir lumber	M	38.00	—	53.00
Hemlock	M	24.50	—	40.00
Tarred felt (14-lb.-sq.)	ton	64.00		
Roofing pitch	ton	14.00	—	22.00
Asphalt coated roofing (35-55-lb. sq.)	sq.	1.30	—	2.50
State surfaced asphalt shingles	sq.	5.25	—	5.50
Corrugated galvanized iron	ton	109.00	—	127.00
Putty	100 lb.	6.75	—	.....
Red oxide (Ppte. Copperas)	100 lb.	15.00	—	20.00
Native red oxide	100 lb.	5.25	—	8.00
Red metallic paint	100 lb.	1.20	—	1.50
White lead in oil	100 lb.	13.50	—	11.42
Red lead in oil	100 lb.	14.00	—	11.84
Zinc oxide (dry)	100 lb.	13.00	—	14.50
Zinc oxide—leaded	100 lb.	9.00	—	10.00
Yellow ochre	100 lb.	1.50	—	10.00
Ultra marine blue	100 lb.	14.00	—	50.00
Prussian blue	100 lb.	135.00	—	150.00
Chrome green	100 lb.	40.00	—	70.00
Paris green	100 lb.	43.00	—	49.00
Mineral black	100 lb.	1.75	—	2.25
Powdered bone black	100 lb.	5.50	—	12.00
Lampblack	100 lb.	15.00	—	45.00
Gas carbon	100 lb.	16.00	—	25.00
Mexican petroleum pitch	100 lb.	1.00	—	2.00
Gilsonite	100 lb.	2.00	—	2.50
Coal tar pitch	100 lb.	.40	—	1.00

STRUCTURAL IRON

Blue annealed sheet iron	ton	84.00	—	89.00
Black sheet iron	ton	96.00	—	104.00
Galvanized iron	ton	105.00	—	170.00
Tern plate, 8-lb. coating	ton	150.00	—	.....
Tern plate, 15-lb. coating	ton	177.50	—	.....
Tern plate, 25-lb. coating	ton	200.00	—	.....
Tern plate, 40-lb. coating	ton	240.00	—	.....
Tin plate, prime	ton	155.00	—	.....
Tank plates	ton	65.00	—	70.00
Beams, channels, angles, T's, Z's	ton	60.00	—	65.00
Rivets	ton	88.00	—	92.00
Steel pins, ¾ to 3-inch	ton	51.00	—	.....
Bar iron and steel	ton	60.00	—	70.00
Chain (1 inch proof coil)	ton	150.00	—	.....
Nails, bolts, nuts, washers	ton	70.00	—	80.00
Tool steels, special alloys	ton	300.00	—	500.00
Bessemer pig iron	ton	37.25	—	.....
Bessemer steel	ton	47.50	—	.....
No. 2 foundry	ton	33.50	—	.....
Steel billets (4 x 4)	ton	47.50	—	.....

POWER HOUSE SUPPLIES

Steam packing, rubber duck	lb.	.99	—	1.10
Asbestos, high pressure	lb.	1.76	—	.....
Asbestos, wired	lb.	1.30	—	.....
Asbestos, graphited braid	lb.	1.21	—	.....
Asbestos, wick	lb.	.75	—	.....
Rubber, sheet	lb.	.66	—	.....
Cup grease	lb.	.07	—	.....
Transmission grease	lb.	.07	—	.....
Axle grease	lb.	.04½	—	.....
Gear grease	lb.	.04½	—	.....
Cotton waste	lb.	.08½	—	.13
Hose, underwriters, 2½ in	ft.	.75	—	.....
Hose, air, ¾ in	ft.	.30	—	.60

INDUSTRIAL NEWS

Plant Construction—Catalogs—New Publications

Construction and Operation

Alabama

WOODWARD.—The Woodward Iron Co., will build a plant to manufacture steel products principally for Government steamship construction. Estimated cost, $25,000,000.

California

AZUSA.—The Awl Fumigating Co., will build a plant for the manufacture of cyanide. Estimated cost between $100,000 and $150,000. Irving Dengle, manager.

LOS ANGELES.—The City Council voted to submit to the people at the fall election a proposition to vote on $130,000 bonds for the construction of sewerage system and treatment plant at the Wilmington Harbor District. A. C. Hansen, City Engineer.

Colorado

DENVER.—L. M. Styles, has purchased a site at 4th and Navajo Sts., on which he will build a plant for the manufacture of mica.

PEARL.—B. H. Lobdell, will build a 50-ton mill to treat ore from the Wolverine mine.

Connecticut

BRIDGEPORT.—The Union Metallic Cartridge Co., Railroad Ave., has awarded the contract for the construction of a two-story, 60 x 240 ft., concrete, brick and steel factory, concrete foundation, to the T. J. Pardy Construction Co., 15 Fairfield Ave. Estimated cost, $35,000.

HARTFORD.—The Hartford Rubber Co., Park St., has awarded the contract for the construction of a 2-story, 60 x 100 ft., rubber factory on Bartholomew Ave., to J. H. Grozier Co., 721 Main St. Estimated cost, $35,000.

HARTFORD.—Henry Souther Engineering Co., 11 Laurel St., has awarded the contract for the construction of a 2-story, 35 x 35 and 35 x 45 ft., brick laboratory to Porteus Walker Co., 13 Forest St., Hartford. Estimated cost, $15,000. Noted Aug. 15.

OAKVILLE.—The Autotyre Co., will build a 1½-story, 49 x 110 ft., addition to its factory. Estimated cost, $20,000. Guion Thompson, 27 West Main St., engineer.

STAMFORD.—Baer Brothers, 700 Canal St., has awarded the contract for the construction of a 5-story, 76 x 115 ft., reinforced concrete, brick and steel factory for the manufacture of bronze powder, to Thompson & Binger Inc., 280 Madison Ave., New York City. Estimated cost, $175,000.

Florida

GAINSVILLE.—The Gillett Oil Co., 1015 Citizens Bank Building, Tampa, has taken over the plant of the Florida Industrial Corporation and will operate it as a castor oil plant under Government control.

JACKSONVILLE.—The American Agricultural Chemical Co., Herald Building, has awarded the contract for the construction of a 2-story, 240 x 401 ft., reinforced concrete plant for the manufacture of fertilizer, to the Turner Construction Co., 244 Madison Ave., New York City. Noted Aug. 15.

TAMPA.—The War Dept., Washington, D. C., will build a plant to manufacture phosphorus for screening ship and troop movements; use 26,000-kw., electric power. W. G. Lockwood, Hillsboro Hotel, investigating for site.

Illinois

GRANITE CITY.—The National Enameling & Stamping Co., will build a 1-story, 100 x 200 ft., reinforced concrete, brick and steel lime burning plant. Estimated cost, $100,000. Engineering Service Corporation, Railway Exchange Building, St. Louis, Mo., engineers.

Indiana

NEW ALBANY.—The Calumet Fertilizer Co., has awarded the contract for the construction of a 1-story, 100 x 250 ft., reinforced concrete, brick and steel factory, to the Austin Co., 1611 Euclid Ave., Cleveland, Ohio. Estimated cost, $60,000.

Iowa

GARNER.—City will build a system of sanitary sewers and a sewage disposal plant. J. G. Thorne, 317 Howes Block, Clinton, town engineer.

Kansas

BAXTER SPRINGS.—The Hocker Development Co., Miami, Okla., will build a 175-ton concentration plant and is in the market for mill lumber, roofing, gas engine, belts, sludge and slime tables, drills, and air compressors. Estimated cost, $60,000. M. W. Pysher, superintendent.

Louisiana

MONROE.—The Republic Gas & Carbon Co., Reading, Pa., will build a carbon plant here.

Maryland

BALTIMORE.—The Maryland Color Printing Co., Holliday and Hillen Sts., has awarded the contract for the construction of a 6-story, 83 x 120 ft., reinforced concrete addition to its plant to the Consolidated Engineering Co., 243 Calvert Bldg.

BALTIMORE.—The United States Public Health Service, will build a hospital building and fumigating plant at Quarantine here.

Michigan

HIGHLAND PARK.—City will install filter equipment superstructure and piping. Estimated cost, $75,000. L. C. Whitsit, City Hall, engineer.

SAGINAW.—The General Motors Corporation, will build a foundry plant for the manufacture of automobile castings to consist of a 163 x 440 ft. foundry, 100 x 400 ft. core building, 110 x 265 ft. cleaning room, 100 x 120 ft. pattern shop and storage building. Estimated cost, $1,100,000. F. D. Chase, Inc., 122 South Michigan Ave., Chicago, Ill., engineer.

SAGINAW.—The Saginaw Malleable Iron Co., Center and Salt Sts., has awarded the contract for the construction of a 140 x 400 ft. foundry, to J. S. Kerns, Detroit, Mich. Estimated cost, $125,000.

Mississippi

PASCAGOULA.—The City will equip a sewage disposal plant, with accessory requirements. Estimated cost, $100,000. F. Johnson, Mayor.

Missouri

BELL CENTER.—The Bankers Mining Co. has awarded the contract for the construction of a 250-ton concentration plant to A. Jeffcott, Joplin. Estimated cost, $50,000. The company is in the market for steam engine, boilers, crushers, sludge and slime tables, roofing, lumber, air compressors, drills, belts, pipes, mill hardware, conveyors, track and ore cars.

DUENWEG.—The Silver Plume Mining Co. will remodel its 200-ton concentration plant and is in the market for sludge and slime tables, air compressors, roofing, mill hardware, lumber, drill, ore cans and car track. Estimated cost, $25,000. H. W. Logan, Duenweg, superintendent.

JOPLIN.—The Big Elk Mining Co. will build a 250-ton concentration plant and is in the market for sludge and slime tables, crushers, mill hardware, lumber, air compressors and engine boilers. Estimated cost, $65,000. L. R. Ealestor, Kansas City, superintendent.

KANSAS CITY.—The Upjohn Co., 22nd and Oak Sts., leased a 3-story building and will install machinery to increase the output of chemicals.

ST. LOUIS.—The Johnson Tin Foil & Metal Co., 6030 South Broadway, has awarded the contract for the construction of a 2-story, concrete plant to Murch Bros. Construction Co., Railway Exchange Building. Estimated cost, $35,000.

ST. LOUIS.—The La Clede Gas Light Co., 11th and Olive Sts., will build a 1-story, 200 x 1200 ft., steel plant for the manufacture of munitions. G. B. Evans, engineer.

New Jersey

CAMDEN.—The Concrete Steel Co., Pennsylvania Building, Philadelphia, Pa., will build a 1-story, 50 x 120 ft., addition to its plant at Delaware Ave. and Pearl St.

PATERSON.—The Mazzarella Piece Dyeing Co., 176 Sheridan Ave., has awarded the contract for the construction of a dye house to Stephen Moshier & Son, 92 Albion Ave. Estimated cost, $4000.

TRENTON.—The Shaw Pottery Co., Park Ave., will build a 1-story, 35 x 60 ft., addition to its plant.

New York

BUFFALO.—The Lumen Bearing Co., 167 Lathrop St., will build a 1-story addition to its brass foundry. Estimated cost, $5000.

BUFFALO.—The National Analine & Chemical Co., Edgewood Arsenal, has awarded the contract for the construction of a 1-story, 40 x 52 and 80 x 80 ft., reinforced concrete, brick and steel plant on Buffalo River, to J. W. Cowper Co., 724 Fidelity Building. Estimated cost, $75,000.

BUFFALO.—The Prest-O-Lite Co., 206 Amsterdam Ave., New York City, will build a plant on Hopkins St. and Colgate Ave., here which will consist of four units.

CORNING.—The Corning Glass Works will build a 3-story, 60 x 120 ft. addition to its plant on Walnut St.

ROCHESTER.—The Symington Anderson Co., Cutler Building, will build a 1-story, 40 x 118 ft., addition to its plant on University Ave., for the manufacture of guns. Estimated cost, $15,000.

Ohio

BUCYRUS.—The American Clay Machinery Co., will build a 1-story, 100 x 250 ft., reinforced concrete, brick and steel factory. Estimated cost, $60,000.

CLEVELAND.—The American Bronze Honor Roll Co., 244 West 23rd St., New York City, will build a 2-story, concrete and brick factory here. Estimated cost, $25,000.

CLEVELAND.—The Buckeye Bronze Manufacturing Co., 1807 Columbus Road, will build a foundry.

CLEVELAND.—The Central Brass Co., 6200 Cedar Ave., has awarded the contract for the construction of a 1-story, 35 x 72 ft., reinforced concrete and brick foundry at 6203 Cedar Ave., to Minnick Gibbons, 5309 Prospect Ave. Estimated cost, $7500.

CLEVELAND.—The City has authorized the Director of Public Utilities to expend a sum not to exceed $20,000 for chemicals for the Division of Water.

CLEVELAND.—The Var Oil & Paint Co., 929 Schofield Building, has awarded the contract for the construction of a 1-story, 45 x 100 ft., reinforced concrete, brick and steel factory, to the Austin Co., 16112 Euclid Ave. Estimated cost, $25,000.

JOHNSTOWN.—The city will build a garbage disposal plant and sewage disposal plant. Estimated cost, $775,000. J. W. Cramer, city clerk.

LORAIN.—The City has awarded the contract for the construction of filter bottoms and manifold castings for waterworks improvements, to the Pittsburgh Filter Co., Farmers Bank Building, Pittsburgh, Pa. Estimated cost, $100,000.

TOLEDO.—Maternity & Childrens Hospital, will build a 3-story, 45 x 122 ft., reinforced concrete and brick hospital on Summit St., to include a pathological laboratory. Estimated cost, $100,000. G. B. Rheinfrank, 601 Gardner Building, engineer.

TOLEDO.—The Toledo Furnace Co., Front St., will build a foundry, two factory buildings and a laboratory, reinforced concrete brick and steel. Estimated cost, $100,000. F. Warner, 768 Hippodrome Bldg., architect.

WARREN.—The International Steel Tube & Rolling Mills, will build six rolling mills and steel tube mills. Estimated cost, $500,000.

YOUNGSTOWN.—The Struthers Furnace Co., Bridge St., has awarded the contract for the construction of a slag crushing plant, capacity 500 tons, to the Baker, Dunbar, Allen Co. Union Arcade, Pittsburgh, Pa.

Oklahoma

CARNEY.—City will build a gas plant. Estimated cost, $4500. Address the Mayor.

DOUTHAT.—The Forth National Lead and Zinc Co., will build a 250-ton concentration plant and is in the market for motors, engines, boilers, sludge tables, belts, lumber, mill hardware, drills, air compressors and conveyors. Estimated cost, $65,000. J. H. Morris, superintendent.

McALESTER.—The City will build a sewage disposal plant. Estimated cost, $110,000. J. M. Gannaway, City Clerk.

MIAMI.—The Lead Boy Mining Co., will remodel and enlarge its 250-ton concentration plant and is in the market for gas engine, sludge and slime tables, crushers, belts, air compressors, drills and mill hardware. Estimated cost, $25,000. R. H. Elkins, Miami, superintendent.

PICHER.—The Cortez Mining Co., Miami, will build a 250-ton concentration plant and is in the market for sludge and slime tables, gas engine, lumber, mill hardware, crushers, air compressors, conveyors and belts. Estimated cost, $65,000. W. T. Landrum, superintendent.

PICHER.—The Hidden Treasure Co., will build a 350-ton concentration plant and is in the market for sludge and slime tables, motors, air compressors, crushers, lumber, hardware, roofing and conveyors. Estimated cost, $65,000. C. S. Campbell, Baxter Springs, superintendent.

QUAPAW.—The Red Rose Mining Co., will build a 200-ton concentration plant and is in the market for crushers, lumber, mill hardware, belts, pipe, air compressors, ore cars, track and conveyors. Estimated cost, $65,000.

ST. LOUIS.—The Kansas Line Mining Co., will build a 300-ton concentration plant, and is in the market for sludge and slime tables, lumber, mill hardware, roofing, conveyors, belts and compressors. Estimated cost, $65,000. W. A. Meese, superintendent.

Oregon

PENDLETON.—The City will build a septic tank for the sewerage. Estimated cost, $25,000. Geary Kimbrell, city engineer.

WALOWA.—The City will build a sanitary trunk sewer and sewage disposal plant.

Pennyslvania

GREENVILLE.—The Sharon Waterworks Co., will extend its filteration plant and beds at the pumping station where a 5,000,000 gallon pump is being installed.

LYKENS.—The American Briquet Co., Drexel Building, will build a 1-story, 50 x 225 ft., briquetting plant. Estimated cost, $200,000. Kern Dodge, 1512 Morris Building, architect.

PHILADELPHIA.—Wm. Cramp & Sons, Ball and Beach Sts., has awarded the contract for the construction of a 1-story, 50 x 220 ft., brick and steel coppersmith shop on Richmond and Morris Sts., to Austin Co., Bulletin Building. Estimated cost, $31,000.

South Carolina

COLUMBIA.—The City will build an additional coagulating basin on the hill east of the old basin, increasing the total capacity to 12,000,000 gallons of filtered water daily. T. K. Legare, city engineer.

Texas

CARLBAD.—City will build a sanitary sewage disposal plant for the State Tuberculosis Sanatorium. J. B. McKnight, superintendent.

DALLAS.—The Trinity Products Co., will rebuild its guncotton plant, recently destroyed by fire entailing a loss of $100,000.

ELECTRA.—City has awarded the contract for the construction of a sewer system and disposal plant, to Winslett & Eldridge Co., 1001 Main St., Dallas. Estimated cost, $52,388.

HILLSBORO.—City will build a sewage disposal plant. Estimated cost, $25,000.

HOUSTON.—The Empire Gas & Fuel Co., will build an oil refinery on ship channel.

LAREDO.—The Laredo Water Co., will improve the waterworks and install a filtration plant.

SAN ANTONIO.—Geo. B. Eligestern, San Antonio, and H. H. Todd, Gainesville, will build an oil refinery. Estimated cost, $350,000.

Virginia

ALEXANDRIA.—The Alexandria Water Co., will build a gravity filtration plant, daily capacity 2,000,000 gal. Estimated cost, $130,000. D. J. Howell & Son, Union Trust Building, Washington, D. C., engineers.

CLINCHFIELD.—The International Coal Products Corporation, 24 Broad St., New York City, will build a plant for the manufacture of carbocoal. The Clinchfield Carbocoal Corporation being organized will operate the plant to distill coal to recover toluol, benzol, naptha, ammonia, creosote, etc. and manufacture residue into fuel briquets. The plant is under Government supervision.

RICHMOND.—The Chesapeake & Ohio Ry. Co., will build a 100 x 400 ft., plant for the manufacture of nitrogen, oxygen, acetylene and other gases. K. T. Crawley, Industrial Agent.

RICHMOND.—The Chesapeake & Ohio Ry. Co., has awarded the contract for the construction of a 1-story, 52 ft. 10 in. x 244 ft. brick and steel brass foundry, to Arnold & Co., 105 South La Salle St., Chicago, Ill. Estimated cost, $50,000.

Washington

SEATTLE.—The Kilbourne-Clarke Manufacturing Co., 24 West Connecticut St., has awarded the contract for the construction of a wireless-manufacturing plant consisting of a 1-story, 100 x 300 ft., machine shop, 2-story, 60 x 100 ft., store house, 1-story, 60 x 100 ft., laboratory, and a 2-story, 60 x 60 ft., office building, at 3450 East Marginal Way, to Fred Woodaman, Seattle. Estimated cost, $80,000.

West Virginia

LINN.—The Monongahela Valley Traction Co., Parkersburg, will build a gas-producer plant.

Wisconsin

CUBA.—The National Zinc Ore Separating Co., will build an acid plant. C. Barker, superintendent.

NEW DIGGINGS.—The Skinner Roaster Co., Benton, will build an acid plant to be operated under government supervision. Estimated cost, $750,000.

Canada

British Columbia

VANCOUVER.—The Dominion Forestry Service, Journal Building, Ottawa, will build an aeroplane spruce testing laboratory, jointly with the University of British Columbia and the Provincial Government. R. H. Campbell, Journal Building, Ottawa, director.

VANCOUVER.—J. W. McFarlane, 1058 Nelson St., will build a fertilizer plant.

Ontario

BRAMPTON.—The City will build a sewage disposal plant. W. M. Treadgold, town engineer.

KIRKLAND LAKE.—Wright-Hargraves will install a mill at his mine.

PEMBROKE.—The Thomas Pink Co., will rebuild its munitions plant recently destroyed by fire, entailing a loss of about $200,000.

WINDSOR.—City will build a filtration plant.

WINGHAM.—The Farmers Fertilizer Co. will build a fertilizer plant. Estimated cost, $8000.

Quebec

AMOS.—The Penn-Canadian Mining Co., Cobalt Ave., will build a 30-ton concentration plant B. Neilly, manager.

LEVIS.—The city will build a filtration plant. Estimated cost, $100,000. Edouard Hamel, St. Peter St., engineer.

VERDUN.—The British Munitions Co., Ltd., Kings Park, has awarded the contract for the construction of an addition to its shell factory, to E. G. M. Cape & Co., Ltd., 10 Cathcart St. Estimated cost, $30,000.

Industrial Notes

THE METALS DISINTEGRATING CO., INC., announces the removal of its offices from 3 South William Street to 62 Broadway, New York City.

THE METAL & THERMIT CORPORATION'S Toronto office is now at 15 Emily Street.

THE DEARBORN CHEMICAL CO., Chicago, has inaugurated a specialties department for the manufacture and marketing of a number of specialties. One is a rust preventive known as No-Ox-Id, to keep metal parts or finely finished surfaces of the completed machines free from corroding. Another specialty is a cutting oil for use in metal cutting, quenching oils for heat treating, drawing oils and Dearboline, a preparation for cleansing machined parts of emery or grease.

THE SARCO CO., INC., New York City, has opened a new office in Atlanta, Ga., in the Healey Building under the management of C. R. Dunwody.

THE JONATHAN BARTLEY CRUCIBLE CO., Trenton, N. J., had a fire in Plant No. 2 recently but they wish to announce that all business will be taken care of as though nothing had happened and orders will be delivered as specified, with very few exceptions. Arrangements have been made and orders placed for the necessary machinery and equipment and the company expects to be in full operation under its own roof by November 1.

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, has taken an order from the Ordnance Department for 53 150-amp. arc welding machines which will be used in France in connection with portable machine shops carried on motor trucks.

THE AKTIEBOLAGET PORJUS SMÄLEVERKS Co. proposes to build two electric iron-smelting furnaces this summer, which will make a total of five. This company's power is secured from the Porjus waterfall.

THE CONNELLSVILLE FOUNDRY, MACHINE & STEEL CASTINGS CO., iron and steel castings and special machinery, has discontinued the sales office formerly maintained at 901 Park Building, Pittsburgh. All correspondence should be addressed to the general office at Connellsville, Pa.

THE MCKINNEY STEEL CO., Cleveland, Ohio, is erecting four open-hearth furnaces of 65-ton capacity and two more soaking pits, making a total of 16 open hearth furnaces.

THE CHICAGO PNEUMATIC TOOL CO. announces that contract has been let and work started on the erection of an up-to-date addition to their Cleveland plant, which is planned to double the present output. It is expected that work will be completed on the building itself about November first. The necessary equipment has been ordered and it is believed will be delivered and ready for installation by the time the building is completed, so that the additional production contemplated will be available very soon thereafter.

THE RADIUM ORE SAMPLING CO. announces the completion of a $12,000 custom sampler at Montrose, Colorado, for the sampling of rare and precious ores and concentrates. The plant is equipped particularly for the careful handling of carnotite. The company does not assay, purchase or deal in ores or their products.

THE BOOTH-HALL CO., 565 West Washington Blvd., Chicago, Illinois, has contracts for building Booth-Hall electric steel furnaces for the following companies: Consumers Steel Company, Chicago, Illinois, one 3-ton furnace for producing tool steels, and for the Ecorse Foundry & Machine Company, Ecorse, Michigan, one 3-ton furnace for producing steel castings.

T. AN. TESCH has taken over the Aktiebolaget Elektrometald which holds the patents on electric furnaces for pig iron now in operation in Sweden and other countries. He is desirous of getting in communication with American concerns contemplating the construction of modern iron and steel plants, electric or non-electric.

The newly formed NORRBOTTENS JÄRNVERKS AKTIEBOLAGET will construct a new plant at Lulea in northern Sweden consisting of 12 or 14 electric blast furnaces, corresponding charcoal ovens with by-product plants, and houses for officers and employees. The necessary power will be contracted from the Swedish government at the rate of 40,000 kw. This company is controlled by the owners of iron and steel plants in central Sweden for the purpose of procuring electric pig iron to be refined at their respective works or will be obtained from the Lapland district. The plant which is being designed by T. An. Tesch will be one of the world's largest electric pig iron producers.

New Publications

THE JOURNAL OF THE AMERICAN CERAMIC SOCIETY Volume I, No. 1, with date of January, 1918, has recently appeared. The Journal is published under the auspices of the American Ceramic Society and takes the place of the volume of transactions containing the papers presented at the annual meeting. By reason of the high standard of the American Ceramic Society the new journal may be expected to take first place as the exponent of the arts and sciences related to the silicate industries. George H. Brown, Rutgers College, New Brunswick, N. J., is editor.